

# SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY, APRIL 23-25, 1908

THE general meeting of the American Philosophical Society was held at Philadelphia on April 23, 24 and 25. The opening session was on April 23 at 2:30 P.M., and morning and afternoon sessions were held on the following days; with an evening lecture by Professor Henry F. Osborn on April 24, at the hall of the Historical Society of Pennsylvania, which was followed by a reception to the visiting members and friends of the society. The sessions were largely attended. The meeting closed with a dinner at the Bellevue-Stratford on the evening of April 25.

Forty-two papers were presented, covering a wide range of subjects. Among those relating to science were the following:

*Cytomorphosis, a Study of the Law of Cellular Change: CHARLES SEDGWICK MINOT, of Harvard University.*

Cellular change is in the direction of the differentiation of the protoplasm of the cell. As more and more of the undifferentiated protoplasm becomes specialized, the cell loses its plasticity to respond to exterior influences, and the power of the cell to reproduce depends upon the amount of undifferentiated protoplasm remaining. A blood corpuscle, for instance, which contains no undifferentiated protoplasm can not reproduce and must die. In muscle, on the other hand, the small amount of undifferentiated protoplasm remaining in the cell enables it to grow, and repair injuries.

Differentiation is the rule, and its end is the death of the cell.

*Inheritance in Protozoa:* HERBERT SPENCER JENNINGS, of the Johns Hopkins University.

Heredity has never been thoroughly studied among the Protozoa. This paper gives the results of an extensive experimental and statistical investigation of a number of generations of *Paramœcium*, raised from cultures and from "wild" forms. It has been assumed that the inheritance of acquired characters is normal among protozoa, though uncommon among higher forms. The author does not find that inheritance of acquired characters is more common in Protozoa than in Metazoa. "Wild" races of large or small size breed true to type, and in these the larger mate with the larger and the smaller with the smaller as a rule; when different sizes mate they produce different sized offspring, in the few cases where the mating is fertile. The production of new races does not readily occur by either inheritance of acquired characters, by selection or by mating.

*Determination of Dominance in Mendelian Inheritance:* CHARLES B. DAVENPORT, of Cold Spring Harbor, N. Y.

In studying heredity, where a single character is considered which one parent possesses and the other lacks, or a character that is contrasted in the parents, it is generally found that the offspring are alike, and like one parent only. From examples of poultry, of insects, of certain mammals, including man, and certain plants in regard to inheritance that may be described as Mendelian, it is concluded that where a stronger determiner meets a weaker determiner in the germ, dominance is the result. When the character is present in one parent only, we have the extreme case and typical Mendelian inheritance, but

when the determiners are of nearly equal potency the Mendelian law is obscured.

*A Preliminary Report upon a Crystallographic Study of Hemoglobins: A Contribution to the Specificity of Vital Substances in Different Vertebrates:* EDWARD T. REICHERT and AMOS P. BROWN, of the University of Pennsylvania.

The primary object of this research was to determine whether or not corresponding albuminous substances are identical in different species. The results of the investigation, which has covered more than one hundred species of vertebrates, show: (a) the crystals of oxyhemoglobin obtained from any single genus are isomorphous, but unlike those obtained from other genera, unless these genera are closely related or in the same family; (b) specific differences in angle and habit are observed between crystals obtained from species of the same genus, so that it is generally possible to recognize the species by the crystals; (c) the occurrence of several types of crystals of oxyhemoglobin occur in the same species; (d) indications are found in the crystal angles of a substance in the molecule common to all hemoglobins, no matter what the system of crystallization. The application of this method of research to problems in zoological classification and in heredity was pointed out.

*The Excretory Organs of the Metazoa, a Critical Review:* THOMAS H. MONTGOMERY, of the University of Texas. (Read by title.)

*The Effect of Certain Preservatives upon Metabolism:* HARVEY W. WILEY, of the U. S. Department of Agriculture.

Details were given of the work that Dr. Wiley is carrying on, in the study of the effect upon the human organism of a number of preservatives commonly used in the preparation of foods, such as borax, boric acid, salicylic acid and salicylates, sulphur-

ous acid, sulphites, benzoic acid and benzoates, formaldehyde, copper sulphate and potassium nitrate. Experiments with the first five of these preservatives show conclusively that their continued use, in quantities such as are used in food preservation, hinders or prevents metabolism, and may seriously derange the functions of the organism. The other substances enumerated are still under investigation, but the results thus far obtained seem to indicate that they are equally injurious.

*Observations Regarding the Infliction of the Death Penalty by Electricity:* E. A. SPITZKA, of Jefferson Medical College.

This paper sets forth the history of "electrocution," the methods employed and the phenomena observed in this mode of death, together with the post-mortem findings; detailing the observations of the author, based upon 31 electrocutions at Sing Sing, Auburn, Dannemora and Trenton prisons. Compared with other methods, "electrocution" is the most humane method of inflicting the death penalty, because of its efficiency, quickness and painlessness, and it should be adopted in every state in the union.

*Recent Discoveries in the Pathology of Rabies:* MAZŸCK P. RAVENEL, of Madison, Wis. (Read by title.)

*The Brain of Rhinochimæra:* BURT G. WILDER, of Ithaca, N. Y.

Four years ago Garman described a new species of chimæroid from Japanese waters, under the name of *Rhinochimæra pacifica*, giving a brief description of the brain, with figures showing the general form from the dorsum, venter and side. This paper gives a detailed description of the brain of this species, confirming Garman's findings and giving much additional data derived from dissection of the brain.

*Preliminary Report on the Brains of the Natives of the Andaman and Nicobar Islands:* E. A. SPITZKA, of Jefferson Medical College.

There is urgent need for research upon the anatomy of the brains of the exotic races, so rapidly becoming impure or extinct. Through the efforts of Dr. W. W. Keen, president of the society, enlisting the aid of Lord Curzon, Viceroy of India, Mr. Risley, ethnographer for India, and Dr. A. R. S. Anderson, senior medical officer at Port Blair, Andamans, the author was enabled to secure a brain of an Andamanese and one of a Nicobarese. The ethnic characters of these aborigines were discussed, and their brains compared as to size and structure with those of whites, Eskimos, Japanese, Chinese, negroes and Papuans, previously studied.

*A Comparison of the Albino Rat with Man in Respect to the Growth of the Brain and the Spinal Cord:* HENRY H. DONALDSON, of Philadelphia.

A statistical study of the growth of the brain and the spinal cord in the white rat, in which the weight of the brain and of the spinal cord is recorded and compared with the body weight at various stages of the development of the animal. The results are plotted, and from these records the logarithmic curves are drawn. When compared with the curves derived from the same data in the case of man and plotted to a corresponding scale, a close similarity in the curves is noted.

*The Classification of the Cetacea:* F. W. TRUE, of the Smithsonian Institution.

The paper deals with the classification of the toothed whales (sperm whale, beaked whale, porpoises, etc.) and has special reference to the fossil forms. The recent work of Dr. Abel, of Vienna, on fossil cetacea is reviewed and criticized. The opinion is expressed that the *Cetacea* are not directly

derived from Zeuglodonts, and that their origin is not at present known; also that the white whale and the narwhal should not be removed from the family Delphinidae, and that the river dolphin, *stenedelphis*, should, for the present at least, be placed in that family.

*Results of the American Museum Exploration in the Fayûm Desert of Northern Egypt:* HENRY F. OSBORN, president of the American Museum of Natural History.

Professor Osborn gave an account of the American Museum expedition into the Fayûm Desert in search of the ancestors of the elephant. The formations explored were Middle and Upper Eocene. Bradnell and Andrews, between 1901 and 1905, had explored the region, finding ancestral forms of the Proboscidea and of the Hyracoidea, as well as primitive Sirenia and Zeuglodonts. The camp of the American Museum expedition was located to the west of Qasr el Sagra, near the bone quarries opened by Bradnell. Remains of *Arsinoitherium*, *Palæomastodon* and *Mæriotherium* were obtained from these quarries. A reconnaissance into the Zeuglodon Valley, near Gar el Gehannem, was described. The restorations of *Mæriotherium* and *Palæomastodon*, made by Mr. Charles R. Knight, under the direction of Professor Osborn, were exhibited. From northern Africa the elephant stock migrated south through Africa, north into Europe, and northeast and east through Asia into the Americas. From a comparison of the ancestral elephant *Mæriotherium*, with the Sirenian *Eotherium*, it is believed that the sea cows and the elephants are derived from the same stock.

*Additional Notes on the Santa Cruz Typotheria:* W. J. SINCLAIR, of Princeton University.

A presentation of the general conclusions reached, as a result of two years'

study of the Typotheria from the Santa Cruz formation of Patagonia. They appear first in the *Notostylops* beds (uppermost Cretaceous or basal Eocene) and become extinct in the Pampean (Pleistocene). It is generally assumed that the rodents and conies are related to *Typotheria*, but this does not appear to be the case, the resemblances are probably due to convergence. The *Toxodontia* and the *Typotheria* probably had a common origin. The *Typotheria* do not lend much support to the idea of a former land connection with Africa, showing no relationship with the recently discovered Eocene mammals from the Fayûm province of Egypt.

*Stratigraphic Observations in the Vicinity of Susquehanna Gap, north of Harrisburg, Pa.:* GILBERT VAN INGEN, of Princeton University.

Details the results of field work that Professor Van Ingen has been carrying on along the Susquehanna River, above Harrisburg. The formations are found to contain well-preserved fossils and several typical faunas, as, for instance, the Hamilton, Ithaca, etc., are well developed. The findings of the author do not always agree with those of the Second Geological Survey of Pennsylvania, even in regard to structure, a great thrust fault recognized by the author, for example, has rendered the section incomplete, a fact not noted by the survey.

*Further Researches on the Physics of the Earth, and especially on the Folding of Mountain Ranges and the Uplift of Plateaus and Continents, produced by Movements of Lava beneath the Crust, arising from Secular Leakage of the Ocean Bottom:* T. J. J. SEE, U. S. Naval Observatory, Mare Island, Cal. (Read by title.)

*Progress in the Demarcation of the Boundary between Alaska and Canada:* O. H.

TITTMANN, Superintendent of the U. S. Coast and Geodetic Survey.

Details the methods employed in determining and marking the Alaskan boundary. The length of the boundary is about twelve hundred miles, extending from the Arctic Ocean south along the 141st meridian to near Mt. St. Elias, and thence along the coast strip of southeastern Alaska. In southeastern Alaska, aluminum bronze monuments are placed wherever it is practicable to do so, but, as most of the turning points in the line are inaccessible snow-clad peaks, they will be defined by triangulation, connecting with the work of the Coast and Geodetic Survey. The initial point on the 141st meridian, which is also being marked by monuments, was determined by a telegraphic longitude circuit, extending overland from Vancouver through Canadian territory, and by way of Seattle and the United States government cables, to Valdez and thence overland to the boundary.

*A Living Representative of the Most Primitive Ancestors of the Plant Kingdom:* GEORGE T. MOORE, Marine Biological Laboratory, Woods Hole, Mass.

Chodat has derived the green algæ from the Palmellaceæ. In this family he points out that there exist three principal stages or conditions: (1) the *Zoospore* condition, (2) the *Sporangium* condition, and (3) the *Tetraspora* condition. The author thinks that a better starting point is found in *Chlamydomonas*, which also shows three corresponding conditions, in addition to the *Zoospore* type, namely the *Volvox* type, the *Tetraspora* type and the *Endosphæra* type. The *Tetraspora* type of *Chlamydomonas* has developed into the *Palmellaceæ* and thence into the algæ and higher green plants. Even as high as the mosses and ferns a *Chlamydomonas* stage is to be seen in the male gametes.

*The Influence of Heat and Chemicals on the Starch Grain:* HENRY KRAEMER, of Philadelphia.

From a study of "reserve starches" and their behavior in relation to heat and chemicals, Professor Kraemer concludes: (a) The starch grain consists of two nearly related substances, the one a colloid, which takes up aniline stains, and the other a crystalloid, which becomes blue with iodine (b) The starch grain is made up of concentric layers, one series of which contains a large proportion of crystalloids, while the other alternate layers are composed mostly of colloids. (c) The polarization effects produced by the starch are attributed to the crystalloidal substance. (d) The starch grains retain their polarizing properties up to 180° C. (e) At the higher temperatures, in the case of the potato starch, the double refraction becomes stronger. (f) While heating the starch grains in water rapidly changes the structure of the grain, it is upon the addition of chemicals or ferments that denaturation is brought about.

*A Contribution to the Knowledge of the Fungi of Pennsylvania; Gasteromycetes:* D. R. SUMSTINE, Wilkesburg, Pa.

This is the initial paper by the author giving a list of the fungi growing in Pennsylvania, and deals with the *Gasteromycetes*. Keys for the determination of orders, families, genera and species are given; about sixty species of *Gasteromycetes* are enumerated and their distribution is given by counties. The paper includes a bibliography of Pennsylvania mycology and a short sketch of the mycologists who have worked in this field.

*Leaf Structures of the Bermuda Sand Strand Plants:* JOHN W. HARSHBURGER, of the University of Pennsylvania.

The paper describes the adaptation of the leaf structures of the Bermuda sand

strand plants to the environment, as shown by a histological study of the leaves. The epidermal structures developed in the leaves to prevent transpiration and desiccation, brought about by the intense light and heat of the sun and the reflection of the white sand, are described and illustrated. Thickening of the cuticle, the development of water-storage tissue, and a hairy covering and the depression of the stomata are the principal changes brought about by the exterior conditions.

*The Explosion of the Saratoga Septic Tank:* WILLIAM PITT MASON, of Troy, N. Y.

The explosion of a tank used for the storage of sewage, and supposed to be due to the ignition of an explosive mixture of marsh gas and air, is discussed. The marsh gas is derived from the fermentation of the sewage, and the ignition is assigned to the generation of phosphine, which is supposed to have ignited spontaneously.

*Some Chilean Copper Minerals:* HARRY F. KELLER, of Philadelphia.

The author describes a number of raw minerals containing copper, from the mines in the Province of Tarapaca, Chile. Among these, the most interesting are pelocnite, a manganese ore containing a considerable proportion of copper; a new double sulphate of copper and magnesium, isomorphous with chalcantite; and a beautifully crystallized sulphate and arsenate of copper, which could not be identified with any known species. The author expects to follow this communication with others on minerals from Copaquira, Huiquintipa and other Chilean localities.

*Absorption Spectra of Solutions:* H. C. JONES, of Johns Hopkins University.

The object of the present investigation was to ascertain whether combination between the solvent and dissolved substances

had any effect upon its power to absorb light. Certain salts in the anhydrous state have very different absorption than when combined with water. A solution of anhydrous neodymium chloride in absolute alcohol gives absorption bands differing from those obtained when a few per cent. of water is added. The application of this observation to the author's theory of hydration is discussed.

*Effect of an Angle in a Wire Conductor on Spark Discharge:* FRANCIS E. NIPHER, of St. Louis.

The problem to be solved is to determine the real current direction in a wire, through which a spark discharge is passing. The spark discharge was that of a long eight-plate machine. One terminal was grounded on a water pipe, the other was grounded in the air. A small wire bent at a sharp right angle was placed vertically in the lines of the earth's magnetic field, and so connected that the negative discharge could be sent either up or down around the angle and its effect recorded on a photographic plate placed under the angle. Very interesting photographic results were obtained, but the author does not consider that the main question was conclusively answered. The work is to be continued, using a platinum wire of .002 inch diameter. The electrometer will probably be a means for examining the two sides of the angle, and it can be used with a continuous current running through the fine platinum wire.

*Some Results of the Ocean Magnetic Work of the Carnegie Institution of Washington:* L. A. BAUER, of Washington.

Dr. Bauer described the work of the *Galilee* expedition in the Pacific since August, 1905. The work accomplished, briefly stated, is as follows: (a) magnetic observations have been made on the ocean areas which closely approach land observa-

tions in accuracy; (b) errors found in magnetic charts of the Pacific Ocean amount to from  $1^{\circ}$  to  $5^{\circ}$  in declination (or variation of the compass) and in dip, and about .04 in the horizontal magnetic force. The correction of such errors, especially the error in declination, is of great importance for the safe and rapid navigation of vessels.

*The Investigation of the Personal Error in Double Star Measures which depend on the Position of the Angle:* Mr. ERIC DOOLITTLE, of Philadelphia.

This paper gives the result of the determination of the constant personal errors, and also of the probable uncertainty of the measures, of double stars made during the past ten years at the Flower Astronomical Observatory of the University of Pennsylvania. Some eighty thousand single measures are available for the investigation. The double stars observed are divided into four classes and the law of occurrence of error deduced for each class. It is shown that for each class the personal error is well determined, so that from measures actually made the true value can be quite approximately determined.

*Astronomical Photography:* JOHN A. BRASHEAR, of Allegheny, Pa.

Dr. Brashear spoke of the advantages of the photographic over the visual method of astronomical observation, and rapidly sketched the history of the development of astronomical photography, from the time of Draper to the present. He also exhibited a number of photographs of celestial objects, such as star clusters, nebulae, comets, the moon and planets, etc.; a large proportion of which were made with the 10-inch Brashear lens of the Bruce telescope of the Yerkes Observatory.

*Relative Advantages of Various Forms of Telescopes for Solar Research:* GEORGE

E. HALE, of Solar Observatory, Pasadena, Cal.

Professor Hale discussed different types of telescopes for solar research, describing particularly the equipment at the Solar Observatory of the Carnegie Institution at Mount Wilson, California. The advantages of the fixed horizontal telescope with heliostat were pointed out. The author also described the large spectroheliograph of this observatory and exhibited a number of examples of photographs taken by means of this instrument, including solar prominences, faculae, and sunspots.

*Photographs of Daniel's Comet:* E. E. BARNARD, of the Yerkes Observatory.

The comet was photographed on thirty-eight nights with the Bruce photographic telescope of the Yerkes Observatory. This is one of the brightest comets that have been visible since the great comet of 1882. It was visible to the naked eye for about two months during the summer. The photographs showed that the most active period in the comet's history occurred nearly a month before perihelion, at which time changes occurred so rapidly that the appearance of the comet changed from night to night. Indeed, on comparing the Yerkes Observatory photographs with photographs made at M. Flammarion's observatory in France, and at the Lick Observatory on the same night, marked differences in the photographs could be seen.

*The Solution of Algebraic Equations in Infinite Series:* PRESTON A. LAMBERT, of Lehigh University.

The object of this investigation is to develop a general method for determining all the roots of any algebraic equation, by means of infinite series. The method consists in forming algebraic functions of  $x$  from the given equation  $f(y) = 0$  by introducing a factor  $x$  into all the terms but two of the given equation. These algebraic

functions are expanded into power series in  $x$  by the multinomial theorem, by MacLaurin's series, or by La Grange's series. If, in these power series,  $x$  is made unity, the resulting series, if convergent, determine the roots of the given equation. The convergency conditions determine in advance in which two terms of the given equation the factor  $x$  is to be omitted.

It is shown that all roots of the given equation can be determined by means of infinite series, derived by that method.

*The Completion of the Lunar Theory and the Tables of the Moon's Motions to be made therefrom:* ERNEST W. BROWN, of Yale University. (Read by title.)

*Problems of Three Bodies on Surfaces:* EDGAR ODELL LOVETT, of Princeton University. (Read by title.)

Other papers of a general nature read at this meeting were the following:

*The Law of Oresme, Copernicus and Gresham:* THOMAS WILLING BALCH, of Philadelphia.

*The Dramatic Function of Cassandre in the Oresteia of Æschylus:* WILLIAM A. LAMBERTON, of the University of Pennsylvania.

*Goethe's Private Library as an Index of his Literary Interests:* WATERMAN T. HEWETT, of Cornell University, Ithaca, N. Y.

*Art and Ethnology:* EDWIN SWIFT BALCH, of Philadelphia.

*A Vedic Concordance:* Professor MAURICE BLOOMFIELD, of Johns Hopkins University.

*On the Lost Tribes of Israel and the Aryan Ancestry of Jesus and His First Disciples:* PAUL HAUPT, of Johns Hopkins University.

*The Sign and Name for Planet in Babylonian:* MORRIS JASTROW, JR., of the University of Pennsylvania.

*Medieval German Sculpture in the Germanic Museum of Harvard University:* KUNO FRANCKE, of Harvard University.

*Notes on Greek Vases in the Museum of Science and Art of the University of Pennsylvania:* PROFESSOR WILLIAM N. BATES, of the University of Pennsylvania.

The balloting for new members took place on Saturday morning, April 25, and those were elected whose names were printed in the last issue of SCIENCE.

The meeting concluded with a dinner at the Bellevue-Stratford, at which Vice-president William B. Scott, of Princeton, presided, and toasts were responded to by His Excellency, Mr. Wu Ting-fang, Dr. Horace Howard Furness, Professor William Gilson Farlow, Dr. Harvey W. Wiley and Hon. Hampton L. Carson.

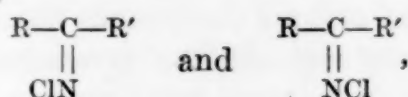
#### THE APPLICATIONS OF PHYSICAL CHEMISTRY TO ORGANIC CHEMISTRY<sup>1</sup>

To do justice to the subject, the "Applications of Physical Chemistry to Organic Chemistry," one would have to touch on all the chapters of organic chemistry: there is no branch of it that can not be put into more precise and therefore clearer terms with the aid of physico-chemical ideas. In the time at our disposal to-day it will be necessary for me to limit myself to a few illustrations.

We might begin with the simple device which we owe to physical chemistry of identifying a solid substance most positively by taking a melting-point not only of the substance itself, but also of a mixture of it and the compound it is suspected of being: this device was hardly known or used fifteen years ago and is now considered a more reliable and, certainly, a more rapid identification test than an exact ultimate analysis: I recall that in an investigation

<sup>1</sup> Address before the American Chemical Society, December, 1907.

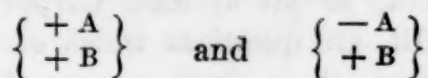
carried out a dozen years ago, two compounds were obtained, each of which melted at  $245^{\circ}$  to  $247^{\circ}$ ; both had the same composition and they were at first supposed to be identical; but mixtures of the two melted  $30^{\circ}$  to  $40^{\circ}$  lower than either substance alone, and this gave us our very first warning that we were dealing with *isomers*. Again, in a more recent investigation on a new class of nitrogen *stereoisomers*, the syn and anti chlorimido compounds,



we were on the point of abandoning the search for nitrogen stereoisomers other than the long-known oximes and hydrazones, when the simple observation was made that a crude chlorimido ester, melting at  $65^{\circ}$ , gave analytical data representing a perfectly pure substance and yet could be resolved into two distinct compounds, each giving the same analytical results, but each of which melted some twenty degrees higher than the original substance, a mixture of which, however, melted again at  $65^{\circ}$ . Then we knew that we had at last stumbled on the long-sought stereoisomers, the simplest representatives of the whole type. Structural identity being proved, the rigorous proof of stereoisomerism *versus* physical or crystal isomerism was brought in part with the aid of the low melting point of the mixture of the two substances.

The physico-chemical theory of the separation of *stereoisomers* of the asymmetric carbon type, for instance, of the separation of *d* and *l* tartaric acids, by the crystallization of their salts with optically active bases, has led to extremely important and useful developments in recent years; the theory is, in brief, that whereas two opposite forms,  $+A$  and  $-A$ , must have the same physical and chemical properties,

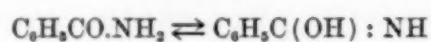
except in the rotation of the plane of polarized light, the compounds



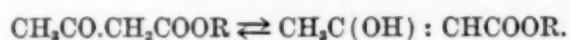
obtained when the two forms are combined with a single active component, say  $+B$ , are no longer optical images and will have different physical and *chemical* properties. The recognition of this simple fact has led to the extension of the method of separation to other substances than acids and bases, namely to esters, amides, hydrazones and so forth. Most important, though, is the fact recognized first by Marckwald that for the same reason the chemical activity of two asymmetric substances,  $+A$  and  $-A$  towards an asymmetric compound  $+B$  may be different and that consequently, for reactions that are not instantaneous like salt formation, but involve time, like esterification, the velocity of formation of the compound,  $+A+B$ , say an ester, may be quite different from the velocity of formation of  $-A+B$ . This must make possible a separation by chemical means, rather than by physical. But, *vice versa*, the velocity of decomposition of such esters when once formed may likewise be different. All these conclusions were confirmed by experiment and the result is of greatest importance to science, for it gives us a direct explanation of the long-known fact that enzymes will attack only one of a pair of stereoisomers and not the other, will cause, for instance, *d*-glucose to ferment, but not *l*-glucose; for in the enzymes we have asymmetrical substances (Fischer) corresponding in every way to what we have symbolized as  $+B$ .

Again, the much-discussed, once hotly fought question of the true structure of so-called *tautomeric* compounds has found its rational solution with the aid of physical chemistry. Whether acid amides have the structure,  $\text{RCO.NH}_2$  or  $\text{RC(OH):NH}$ ,

whether a 1,3 dicarbonyl derivative, like acetoacetic ether, is a ketone,  $\text{CH}_3\text{CO}\cdot\text{CH}_2\text{COOR}$ , or an alcohol,  $\text{CH}_3\text{C}(\text{OH})\cdot\text{CH}\cdot\text{COOR}$ , are questions which could not really find their final answer by the older methods of the study of derivatives, although at the time that was the best we could do. According to the present views, which J. Traube first presented, we have in solutions of the tautomeric compounds both forms in equilibrium with each other; for instance, we have



and

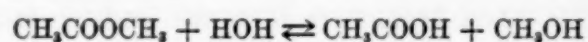


According to the laws of equilibrium and kinetics, if a given reagent, for instance an alkali, uses up the one form, say by neutralization, the whole material can be changed in the same way; the other form, inert in regard to a particular reagent, regenerates the active form continuously by a one-sided reaction. Thus, even if the unstable form existed in only minimal quantity, it could be the source of the actual product of the reaction, and that is why the old method of proof by the study of derivatives must be considered faulty. The isolation of the two closely related forms has not only confirmed this modern view by the qualitative observation that the forms are mutually convertible into each other, but Wislicenus, Claisen, Kuester and others have measured quantitatively the velocities of transformation of tautomers and have determined a number of the equilibrium constants. With the proof by Knorr, showing that in the solid phase only one tautomer can exist in stable form, the whole matter has received a definite, sharp setting. That the subject is one of interest not only to organic chemists, but to all of us, is evident from the fact that our indicators, phenolphthalein, methyl orange and others, seem to owe their valuable

property of changing their tint, in passing through the neutral point, to conditions of *tautomerism* affecting the *chromophoric* groups in these compounds.

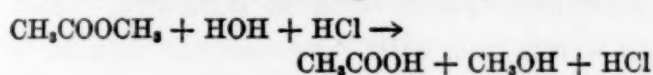
And so we find physico-chemical methods of investigation of the greatest advantage in the treatment of the three important classes of organic compounds which have the same molecular weight and composition but different character and identity—namely, *isomers*, *tautomers* and *stereoisomers*.

But the organic compounds themselves, their structure and the arrangement of their atoms in space, represent in a way the least important side of organic chemistry—far more important are their reactions, the changes to which we can subject them, the things we can do with them. For on these changes all the scientific and technical applications and our very life depends. It is in particular to the study of some phases of this question of organic reactions that I wish to call your attention this morning. To take a concrete case, the reversible reaction of esterification and saponification



has been an important one ever since its study helped establish our fundamental law of chemical equilibrium. But the reaction has been important in other directions as well, for early investigations showed that either action is greatly accelerated by the addition of an acid like hydrochloric acid; since the acid did not seem to change or to take part in the reaction, it was said to act by its mere presence as a catalytic agent; and this is a typical reaction from which important laws regarding catalysis were laid down. There are hosts of reactions in organic as in inorganic chemistry in which we use one ingredient or the other to accelerate the action, or rather to make it go at all. It

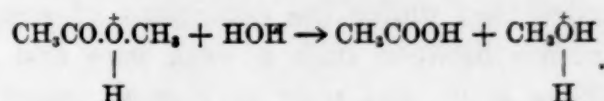
has always been a subject for speculation and investigation as to how and why a catalytic agent like hydrochloric acid does its work in actions like the saponification of methyl acetate or the inversion of cane-sugar or the digestion of food. Many chemists have believed that more reactive addition products are formed as intermediate products; but of what nature would they be to be more reactive? We know that addition products, representing more saturated compounds, very often are really less reactive than the unsaturated compounds from which they are obtained. There are, however, important exceptions to this rule: in trying to imagine just how an acid can affect the speed of the action



we must recall the most fundamental fact concerning acids, the fact that they have the power to form salts with bases and basic oxides. Here we have the acid and the oxide and the idea is at once suggested that *salt* formation of the ester with the acid is the cause of the acceleration or catalysis. Baeyer has shown, in fact, that acid esters in common with other oxygen compounds do form well-defined salts with acids, oxonium salts, derived from quad-rivalent oxygen, salts of exceedingly weak bases, but still true salts, as shown by the electrolytic experiments of Coehn. Now, one of the most important differences between a very weak base and its salts is that almost all salts, no matter how weak the base, ionize much more readily than the weak base itself—this is a general case when the addition product, the salt, is more reactive than the unsaturated compound, the base, and it is so through the power of ionization.<sup>2</sup> So it was thought that the accelerating or catalytic action of

<sup>2</sup> Addition products often have a decomposition tension producing an action as the result of an increased potential of a component.

the acid could be readily understood as due to such salt formation, if the water reacts, not with the ester itself, but only with its positive ion, as expressed in:



The velocity of the reaction would then be simply expressed in the fundamental equation:

$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc. Pos. Ions} \times \text{Conc. HOH}$$

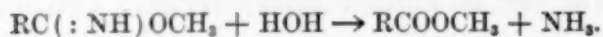
As a matter of fact, with this single assumption that only the positive ions are active, it is possible to deduce mathematically by the rigorous application of our simple laws of chemical equilibrium and dynamics, as applied to the salts of very weak bases, every fundamental fact that has long been known about the processes of saponification and esterification: In the first place, by the application of these laws, we find this equation resolving itself, mathematically, into the equation:

$$\text{Velocity} = \frac{dx}{dt} = K'_{\text{velocity}} \times \text{Conc. Ester} \times \text{Conc. HOH} \times \text{Conc. H ions}$$

the fundamental empirical equation which tells us that at a given temperature the velocity of saponification is proportional to the concentrations of the ester, the water and the hydrogen ions; the innumerable measurements which have established the correctness of this empirical equation agree, therefore, obviously also with the fundamental equation of our theory. The latter is also found to be in perfect agreement with the two other characteristic features of this catalysis—namely, that the ultimate condition of equilibrium of the reversible reaction of saponification and esterification is not sensibly modified by the addition of the acid, but is only reached more rapidly; and finally, the catalyzing acid does not appear to combine with any of the sub-

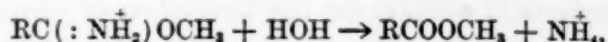
stances involved in the reaction—hence the name catalytic agent. The acid does not appear to combine with the ester simply because the salt is almost completely hydrolyzed under the conditions of equilibrium between such a weak base and a strong acid—and only very small quantities of the salt and its positive ion exist at any moment. But still, if the concentration of a component is increased, say, a thousandfold by the addition of an acid, its reactivity is increased proportionately according to the law of mass action, no matter whether a minute quantity has thus been increased a thousandfold or a larger mass.

Thus far the development of the subject was purely mathematical and theoretical, although no assumption was made which was not based on established facts of organic chemistry. An experimental test of the correctness of this theory necessarily was a main object. The ordinary esters were not considered suitable for the purpose; they are such weak and unstable bases that it was not considered wise to attempt to measure exactly the actual concentration of their positive ions in given cases—although this will now be attempted. Recourse was first taken to a very closely related class of compounds, the imido esters,  $RC(:NH)OCH_3$ , in which the stronger basic group  $(:NH)$  has replaced an oxygen atom of the ordinary esters. The imido esters are pronounced bases, although weak ones, and form well-defined salts. They are decomposed by water into ammonia and an acid ester according to



This action is enormously accelerated by the addition of acids, just as is the decomposition of an ordinary ester. On the basis of the above theory, it was thought that the acceleration of the decomposition of the imido ester would also be due wholly

to the formation of the salt, and, through it, of its positive ion in larger masses; in other words, the real decomposition must be



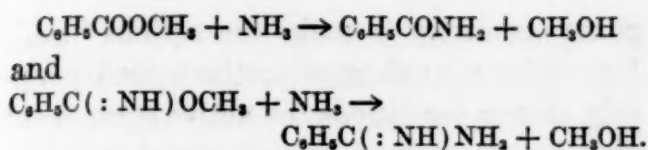
and the isothermal equation giving the velocity of the action must be

$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc. Pos. Ions} \times \text{Conc. HOH},$$

the same as for the acid esters.

In this case the theory could be put to the test of experiment, for all the factors could be determined—the velocity of the reaction, the exact proportion of free ester, its salt and its positive ion at any moment were ascertained without difficulty. Not to weary you with experimental details, it may be said that the substance undergoing decomposition was found, as a matter of fact, to be the positive imido ester ion; the free base, the non-ionized salt do not decompose with water in this way. The deeper the investigation was carried, the more marked, too, was found the parallel between the acid esters and the imido esters, which have served for the experimental verification of the theory; there is an alkaline catalysis of imido esters, as there is of esters, and the alkaline catalysis in both cases is very much the faster one and subject to the same law; there is a salt effect or salt catalysis for the imido esters as there is for acid esters and for cane-sugar, and our measurements help to explain, we believe, the nature of salt catalysis in both cases.

The proof of the soundness of a theory is shown by the experimental verifications of predictions which can be made on the basis of it, and I would like to report two such cases. Imido esters react also with ammonia, as do ordinary esters, and the products are quite analogous; we have:



The latter reaction proceeds very slowly but is accelerated again enormously by the addition of an acid. On the basis of the general theory we supposed at once that the real action does not involve the imido ester itself at all, but only its positive ion, so that we must have

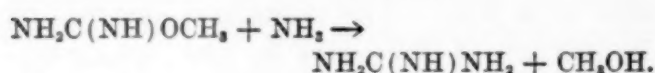
$$\text{Velocity} = \frac{dx}{dt} = K_{\text{velocity}} \times \text{Conc. Pos. Ion} \times \text{Conc. NH}_3.$$

This action is interesting because almost all of the added acid is taken by the stronger base, the ammonia, to form an ammonium salt, the weaker base, the imido ester, taking only a very small share of it. The same catalytic effect can, therefore, be produced also by adding an ammonium salt to the mixture; the weaker base will also take a small part of the acid; but this small share, however minute, can be rigorously ascertained with the aid of the equilibrium law and of the experimentally ascertained affinity constants of the two bases. The mathematical development led to the rather startling prediction that the reaction velocity would be found to be independent of the concentration of free ammonia—one of the reacting components—a result which no one would anticipate from the old view as expressed in the first equation. That is, while accelerating the action proportionately to its mass, the ammonia, according to our view, should also retard it to a like degree by driving the imido ester proportionately out of its combination with the acid and thus its concentration would not affect the reaction. As a matter of experiment, the velocity of the reaction was found, as predicted, to be practically independent of the concentration of free ammonia. In the second place the degree of ionization  $\alpha$  of the ammonium salt figures

in the final mathematical equation—the velocity constant referred to the positive imido ester ions being  $K_v/\alpha$ . Now, ammonium sulphate is ionized considerably less than ammonium chloride in equivalent solutions. When we determined the velocity of the action for methyl imido benzoate, first using ammonium chloride as the catalyzer, we found that it is 281 if  $\alpha$  is left out of consideration, and for the sulphate solution it is 212. The respective degrees of ionization of the salts in the concentrations used are 80 per cent. and 61 per cent., respectively, and for  $K_v/\alpha$  we have  $281/0.80 = 351$  and  $212/0.61 = 351$ . The third point of especial interest is that in this reaction the actual concentration of the reacting substance, the positive ester ion, is exceedingly small; for instance, only 0.000,018 gram molecules at the beginning of our first series, and still smaller as the reaction proceeds, but it is rigorously calculable and it is noteworthy that the velocity is really found proportionate to this small but vital component. This, I believe, also justifies completely the conception that the catalysis of ordinary esters is also due to a very small but vital component, which has hitherto escaped measurement, but the assumption of whose presence enables us to give a rational explanation of catalytic action of acids which is in complete agreement with all experimental facts and with the laws of dynamics.

Another fact discovered as a result of applying the theory is this: in all our determinations we have found the rule to hold that in the presence of an acid catalyzer the tendency for action is for the ion of a weaker base to change into the ion of a stronger one—that is true for the amidine reaction, for the action of water on imido esters and on ordinary esters, and even for the formation of esters from an acid and alcohol; the rule is probably de-

pendent on the law of maximum work and should lead to the recognition of what may be called the driving force of the actions—I have not time to discuss it here. In our experience there was only one notable exception to the rule: years ago we found that urea esters would not react with amines to give guanidines, a reaction which would correspond entirely to the formation of amidines from imido esters:



And, yet, the guanidines are much stronger bases than are the urea esters. Now it happened that in our older work we had almost invariably used the free esters and amines, no salts. In a reinvestigation of the action from the new point of view, hydrochloric acid was added to help the ionization of the urea ester. With this simple modification, the method works beautifully, excellent yields of guanidines are obtained and the action falls into line with the others. Quantitative measurements showed too that the reaction proceeds with a velocity proportionate to the concentration of the positive urea ester ion. The result was interesting not only because it represents a successful synthesis predicted by the theory, but also because in this case the stronger base is the urea ester and it takes the major part of the catalyzing acid—for the imido esters and ammonia the conditions were reversed. And so the theory is found to work, whether the reacting positive ions are present in very minute or in larger masses, whether the catalyzer combines in minimal or in larger proportion with the substance undergoing catalysis!

We thus find that it is possible by physico-chemical methods to determine the mode of action of reagents, so-called catalyzers, which we add to mixtures in or-

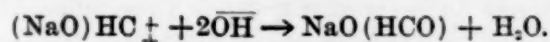
ganic chemistry to make the actions "go." By entirely analogous methods and properly chosen conditions the active component may be ascertained by velocity determinations in a large variety of organic reactions, methods which are applicable not only in chemistry proper, but also particularly in the domain of biochemistry, where catalytic action by acids, alkalies and enzymes is of foremost importance.

In conclusion, I should like to call attention to one other important method of physical chemistry which has been extensively applied in inorganic fields and is now being used in organic work with the largest promise of valuable results. It is the method of studying chemical reactions with the aid of potential differences produced by a logical arrangement of reacting substances—a method which Ostwald seems to have originated and which he has developed into a chemometric method. One of the most valuable applications is in the study of oxidation and reduction, and it was, in fact, first used by Ostwald in such reactions in an investigation carried out with Bancroft. Such potential differences, according to the theory of Nernst, amply confirmed by experience, are a function, in the first place, of characteristic constants of the reacting substances and, in the second place, also, of the concentrations of the reacting substances, the ions, around the electrodes. The application to an organic problem will become clear by the consideration of a specific case. We remember that the oxidation of a great many organic compounds like aldehydes and sugars is most vigorous in alkaline solutions. We use ammoniacal silver solution and even sodium hydroxide with it as a most delicate test for such aldehydes, and alkaline Fehling solution for sugars. Is the alkali necessary to liberate silver oxide or copper oxide as the true oxidizing agent, as is often sup-

posed? The physico-chemical method of investigation shown here easily leads to a correct analysis of the action; as a matter of fact, we find silver nitrate a far more powerful oxidizing agent than is ammoniacal silver oxide, and it is so because in both cases the oxidation is due to the tendency of the silver ions to discharge their positive electricity and that positive electricity is the real oxidizing agent here just as it is at the positive pole in every case where a current is passed through any solution whatever. In the silver-nitrate solution there is a far greater concentration of these discharging silver ions than in the ammoniacal solution, in which most of the silver is present in the rather stable complex ion,  $[\text{Ag}(\text{NH}_3)_2]$ . But the alkali is used to increase the concentration of the active reducing component of the aldehyde—which probably is a methylene salt  $\pm \text{CH}(\text{ONa})$  or its ion<sup>3</sup>—the alkali added to the silver nitrate is positively detrimental to the latter's oxidizing power. (Illustrated by an experiment with silver nitrate against formaldehyde and sodium nitrate; then alkali is added to the alde-

<sup>3</sup>The oxidation of an aldehyde is best interpreted as being due to the oxidation of sodium oxymethylene  $(\text{NaO})\text{CH} \pm$ , the two free valences of which may justly be considered to consist of a positive and a negative electric charge. Any oxidizing agent, *e. g.*, the positive current of electricity resulting from the discharge of the silver ions, would oxidize this as follows:

$(\text{NaOCH}) \pm$  and 2 positive charges  $\rightarrow (\text{NaO})\text{CH} \pm$  and the hydroxyl ions of the alkaline solution would by uniting with this residue give sodium formate:



The two sodium ions belonging to the two hydroxyl ions used migrate to the silver nitrate cell in the chemometer, replacing the two silver ions which have been discharged—all of which corresponds to actual observation. (Views developed by Nef, W. A. Noyes and others are in part applied in this interpretation.)

hyde, and finally ammonia to the silver nitrate.) It could be shown in the same way that the alkali used with Fehling's solution in the oxidation of glucose is used wholly for its action on glucose, and is rather a disadvantage than helpful as far as the copper is concerned. This method of investigation enables us, therefore, to analyze the action of our oxidizing and reducing agents, and it promises to lead us ultimately to a mathematical solution of the problem.

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UNIVERSITY OF CHICAGO

#### SCIENTIFIC BOOKS

*Psychology: General Introduction*, pp. 389.  
*Laboratory Manual of Psychology*, pp. 127.  
*Laboratory Equipment for Psychological Experiments*, pp. 257. By CHARLES HUBBARD JUDD, Professor of Psychology at Yale University. New York, Charles Scribner's Sons. 1907.

Professor Judd's contribution to the available facilities for the teaching of psychology is a notable one. The plan is consistent, the execution capable, the result distinctive. The text becomes part one of the series of three volumes; a brief laboratory manual makes possible the performance of a considerable range of demonstrations and individual experiments, all reduced to as simple a material basis as is compatible with convenience; while the third volume furnishes the instructor with a *vade mecum* for management and equipment of his modest instrumental plant. The general plan thus provides for the "object lesson" conduct of an introductory course in psychology, suitable at once to colleges and universities and to normal schools that are ready to give psychology a prominent place in their schedules. The text becomes available alike with such illustrative experimentation and without it, or with such portion of it as meager facilities make possible.

In distinction from the more conventional text which implies and as a rule receives the supplementary exposition of demonstration,

there have appeared at least four distinctive procedures for the rendering of first aid to the psychology inquisitive. Professor Sanford's volume was early in the field and adopted the orthodox laboratory-manual method of furnishing a large range of small experiments, each for the most part devoted to the illustration of a principle or minor factor in a carefully presented and elaborated scheme. Professor Titchener's apparatus is the most elaborate and the most advanced. He introduced the twofold division of a manual for the student and another for the instructor, and again divided the procedures into the qualitative and the quantitative type. Four sturdy volumes thus compose the basis for a course in experimental psychology. Moreover, the principle of the Titchener series is to select relatively few problems in the several fields and give to each a thorough and painstaking treatment, sufficient in many cases to yield a definite result in quantitative form. What is thus gained is a considerable training in the research methods of psychology—the procedures by which the standard results have been reached—or at least a worthy prolegomena thereto; what is sacrificed is the demonstration of a large range of phenomena almost equally important and certainly equally valid as illustrations of psychological principles with which the psychologist, amateur or professional, will have to deal. A third type of manual is that by Professor Witmer, which though a single volume of text, yet carries with it an experimental flavor by including a collection of all manner of devices by which paper and print may serve the experimentalist's purposes, and by an insistent use of questions and set exercises which the student may (if sufficiently urged) carry on to his own benefit. The fourth member is that now added by Professor Judd.

There is much to be said for each of these procedures; and the variety of pedagogical principles and practical experiences will determine the preference or expediency of each. Professor Sanford's idea was in the main that of letting each instructor choose his own text (or furnish it by lectures) and find in the

manual a large enough range of illustrative material so that by choosing, omitting, intruding and transposing, he may build up an experimental course. Such a plan is of permanent value, is more nearly that which has found favor in other laboratory sciences and will always be preferred by a considerable proportion of the teaching psychologists. It is greatly to be regretted that Professor Sanford has not completed his scheme by writing the second part of his manual, which at this stage (with a revision of the first part) would serve the purposes of quite a number of courses now given in colleges. The great emphasis on illustrations of principles, the covering of a large range of observations, the furtherance of direct speaking relations between the student and the common mass of psychological data: these are the points that commend such a method, as well as the adaptability of the course to the perspective or even the prejudices of the instructor. Professor Titchener's plan, equally distinctive, equally legitimate as an ideal, and more suitable to the graduate student, yet inevitably is limited to a smaller and more professionally interested clientele. The work is authoritative in its own field and indispensable to any one engaged in the experimental enlightenment of students. Yet the attitude and the interest fostered by the Titchener volumes will fail to appeal to a considerable number of worthy students, whose ambition to become familiar with the spirit of the experimental inquiry in psychology deserves recognition. Professor Witmer's volume has the largest popular appeal; it aims to satisfy a less persistent type of interest and does so with skill and success; it is wholly free from the unfortunate type of popularization characterizing Professor Scripture's volume (in construction a very able book), while yet it pretends to be nothing other than what it is. It may be characterized without disparagement as a good summer-school course in psychology. Professor Judd's series occupies the middle ground in the group. It forms a system of text and experimentation, though with a possible independent use of each; like the Titchener series, it gives practical laboratory

guidance to the instructor; like that, too, though not for like reasons, it limits its practical exercises to a rather few problems; yet it shares with Sanford the emphasis of principles and takes for granted about the same level of maturity and earnestness of interest as does the use of the Sanford volume. Yet Judd's book is compatible with the very minimum of hours devoted to practise work, and in that emulates the Witmer volume. It thus becomes clear that the Judd series should find a place amid the sorts and conditions that affect the instruction in psychology in our colleges, and with a favorable environment and able handling, the volumes will do good service. They will also serve the cause of psychology by making available and thus comprehensible to a larger body the close relation of views on life and mind and the scientific attitude towards their examination.

Without risking further so much of the odium of comparison as seemed necessary to place Professor Judd's volume among its fellows, one may proceed to some account of the text. Professor Judd favors an indirect and objective attack upon the problems of mental experience. An introductory setting forth of psychology, what it aims to do and how it proceeds, a survey of the nervous system in its evolutionary phases, a more minute survey of the nervous system of man and of its action, precede the general unfoldment of conscious experience from which the rest of the volume takes its order and unfoldment. For the systematic groupings and analyses of mental experience prove to be those connected with sensations and their functional issue in relations to the outer world with its setting in space and time, and then most naturally the culmination and motivation of these in the expression of action and behavior. The conduct thus resulting presents gradations and complications, and in turn involves subjective attitudes and analyses of various degrees of complexity. Instinct, memory, imagination, the self feelings, impulse and choice, further engage the psychologist's attention, while two concluding chapters, the one upon dissociation and the other upon applications of psychology,

widen the outlook to include certain corners of the abnormal field and the embodiment of psychological results in educational practise.

Every one having to do with texts in his teaching specialty comes to regard a new applicant for favor under apperceptive criteria of his own. The present writer considers first the content, the material presented, the perspective of topics and the enlightenment available: what kind of a table has the psychological caterer set? He considers next—though really concomitantly—the spirit of the presentation, the tone, the attitude of the craftsman. This is more than the palatability of the viands; it involves the underlying chemistry of food preparation, the esthetics of the art culinary and a knowledge of appetites and their vagaries and shortcomings. He asks thirdly how will the student react when the feast is spread before him, remembering that the diet is to be adhered to for a semester or longer. The notable success of Professor Judd's text is in the first respect. It sets a substantial and admirably selected diet. The emphasis upon the genetic side of things is real and instructive, not forced, superficial and distorted, as appears in so many attempts in "psychology for teachers." The contact with realities of experience is close; and the student should feel the realism of his study. Again the tone is thoroughly psychological; while thoroughly sympathetic with physiological results, it insists upon psychological interpretations. It equally avoids undue absorption in controversial issues and philosophical speculations. On the second count, except as already involved, commendation must give way to criticism. The author fails to bear in mind that he is teaching, presenting, expounding, not justifying the details of his presentation, or disclosing how he or his brother psychologists have come to hold as they do. This fault of Professor Judd's pages both unduly expands and detracts from their merit, and such digressions are an obstacle to the student and wholly foreign to the underlying purpose of the text. It is an error of judgment rarely found in a text-book in physics, but seems to be a temptation for the majority of writers

of "psychologies." Equally must it be pointed out that the forest does not appear very plainly or very attractively among the trees. There is a little too much detail, a little too little contouring of the larger topography. The map is serviceable, but not illuminating. On the third count the writer must frankly express his doubts. The genus student is a difficult guest and his reactions uncertain. Doubtless he likes not that which is good for him, and partakes in large quantities of what is pernicious. Yet, after all, he has a rather versatile appetite which responds to judicious encouragement. Plainly, the diet must be made attractive. Professor Judd's book is not emphatically unattractive from the student's point of view; yet in this respect, it does not compare in success of achievement with several of its rivals for collegiate favor—notably with Professor Angell's text.

Writing texts is like much else, a matter of temperament. The good text-writer is largely born and not made—at least not by the publisher's solicitation. Nor have the best teachers always proved themselves the best writers of texts. The conditions are not unlike those attaching to the construction of ocean steamships, requiring one model for speed and another for cargo. Each result is a compromise; though some are plainly freighters; and others lightly burdened greyhounds. Solidity of content and attractiveness of exposition are not incompatible; but when they are found in marked degree, the possessor thereof should feel within him the call to write a text. In the meantime we shall be content with what there is, and welcome Professor Judd's volumes to a place among their fellows.

JOSEPH JASTROW

#### SCIENTIFIC JOURNALS AND ARTICLES

*The American Naturalist* for February has an article on "The Law of Geminate Species," by David Starr Jordan, geminate species, being two closely related species, found on opposite sides of some natural barrier. Henri Hus discusses "Fasciations of Known Causation," noting that these abnormalities may be transmitted by seeds or cuttings. Charles A. White treats of "The

Aggregate Origination of Parasitic Plants" and Charles Depéret of "The Evolution of the Tertiary Mammals and the Importance of their Migrations," considering the changes in the fauna of certain European beds as brought about by local evolution and by immigrations from North America and other regions. G. H. Parker considers "Zoological Progress" or the increase in our knowledge of the animal kingdom. Under "Notes and Literature" variation in *Amblystoma tigrinum* finds itself under *Invertebrate Morphology*.

*Bird-Lore* for March-April has articles on "The Home Life of the American Egret," by Frank M. Chapman; "The Background of Ornithology," by Spencer Trotter; "The Nest in the Gutter," by Gilbert H. Trafton, and the third paper on "The Migration of Flycatchers," by W. W. Cooke. Under "The Common Names of North American Birds" Edward H. Perkins proposes changes in some inapplicable names. The Audubon leaflet is by Mabel Osgood Wright and is devoted to the song sparrow. A new bird reservation in Florida, known as the Mosquito Inlet Reservation, is announced.

*The Zoological Society Bulletin* for April is an "Aquarium Number" and deals with all manner of aquatic animals. There are articles on "The Natural Foods of Freshwater Fishes," "Porpoises, Long-lived Fishes"—some of which have lived in the Aquarium for fourteen years—"The Sturgeons, Electrical Fishes and Luminous Fishes." "The Largest Marine Animals" gives much information on the size and weight of many species and "A Large Lobster" records a specimen twenty-three and three quarter inches from tail to rostrum and weighing thirty-four pounds. It is announced that an effort will be made to capture some porpoises by means of a heavy seine and bring them alive to the aquarium.

#### SOCIETIES AND ACADEMIES

THE BOSTON SOCIETY OF MEDICAL SCIENCES  
COMPARATIVE ANATOMY AT THE HARVARD  
MEDICAL SCHOOL

A SPECIAL meeting of the Boston Society of Medical Sciences, devoted entirely to the cur-

rent work of the Department of Comparative Anatomy, was held at the Harvard Medical School on the evening of April 7. A brief paper was presented by every member of the department, and by Dr. Meigs, who has used the laboratory for the histological portion of his studies concerning the physiology of muscle. After the meeting there was an extensive demonstration of preparations illustrating the papers presented, and the laboratories were open for inspection. Serial sections of the eggs of the Mexican axolotl were exhibited, showing all the important stages of maturation and fertilization; eighty of these series have recently been added to the embryological collection. They were specially prepared by Dr. J. W. Jenkinson. From the following abstracts it will be seen that a considerable variety of scientific topics was discussed, all of which are of medical interest.

Dr. E. B. Meigs described the histological differences between relaxed and contracted smooth muscle fibers.

A number of physiologists have supposed that muscular contraction might be the result of the passage of fluid from one part of the muscular tissue to another, and recent comparisons between histological preparations of relaxed and contracted striated muscle indicate that, during the contraction of this form of muscle, fluid passes from the sarcoplasmic spaces into the fibrillæ or sarcostyles.

The present investigation consists in a comparison between preparations of uncontracted and contracted smooth muscle. The results indicate that in smooth muscle also there is a passage of fluid from one part of the tissue to another during contraction, but that the movement in this case is opposite in direction to that which takes place in the case of striated muscle; the contraction of smooth muscle seems to be accompanied by a passage of fluid from the contractile cells to the intercellular spaces.

The histological results in the case of both striated and smooth muscle are in harmony with the reactions of the two tissues to swelling reagents and their opposites. Striated muscle immersed in distilled water, or in various other reagents which are absorbed by

it, slowly goes into contraction; and pieces of muscle which have been caused to contract in this manner may be made to lengthen slowly by immersion in reagents which abstract water from them. Both kinds of reagents have exactly the opposite effects on smooth muscle.

Dr. L. W. Williams discussed the notochordal origin and the histogenesis of the nucleus pulposus. The notochord of the young mammalian embryo is a continuous rod of uniform diameter. It is composed of clearly defined cells surrounded by a thin outer, and a thick mucin-containing inner sheath. The deposition of inter-cellular substance in the embryonic vertebral cartilage squeezes the notochord into the intervertebral discs, where it forms the nuclei pulposi. Within the vertebræ, the notochordal tissue degenerates. The sheaths after becoming calcified are finally destroyed by bone-forming tissue. Within the nucleus pulposus, the loss of cell-walls converts the notochordal tissue into a syncytium with mucin in its meshes. It closely resembles embryonic connective tissue. The notochordal nuclei multiply rapidly by mitotic division. The inter-cellular substance increases in volume and finally separates the syncytium into small vacuolated masses of protoplasm, similar to fat cells. Each cell is spherical and usually has two nuclei, which lie in a small amount of cytoplasm separating two or more large vacuoles. It was shown that the notochord in man normally has a sinuous course in the base of the skull, and that chordoma usually occurs at the points where the notochord comes nearest to the upper surface of the bone.

Dr. V. E. Emmel presented some results of his studies in regeneration and growth. According to Conklin's hypothesis inverse symmetry in mollusca and perhaps also situs inversus in man are due to an inverse organization of the egg, corresponding with maturation at opposite poles. It does not accord with this theory that until the fourth molt the large crusher claw of the lobster may be made to develop on either the right or the left side. In the larval lobster the first pair

of claws or chelæ are alike and symmetrical, but at about the fifth molt a transition from symmetrical to asymmetrical differentiation of the chelæ normally occurs. The experiments were planned to show to what extent asymmetrical differentiation can be controlled by the amputation of one chela, thus giving the remaining chela the greater advantage in growth. The results show (1) that up to the fourth molt right or left asymmetry of the chelæ may be produced at the will of the experimenter; (2) that during the fifth stage (*i. e.*, between the fourth and fifth molts) experimental control ceases; and (3) that in later stages of development, when the asymmetry of the chelæ has become established, the amputation of one or both chelæ does not reverse the original asymmetry. It appears, therefore, that the factors controlling asymmetry become operative after hatching and are correlated with conditions of growth. The histological changes which occur at these stages of growth and regeneration are being studied.

Mr. R. E. Scammon discussed the accessory chromosome as a determinant of sex. He showed original preparations of the male germ cells of insects, similar to those which led McClung to formulate his theory of the accessory chromosome as a sex-determinant. There were also exhibited several preparations of orthopteran germ cells in which the accessory forms part of a huge multiple chromosome. The behavior of the accessory in these forms was discussed in the light of the recent work of Wilson and others, and the relation between the condition of the accessory chromosome in the Orthoptera and other insect types was shown.

Dr. F. W. Thyng described several models of the pancreas in embryos of the cat, rabbit, pig and man. In the embryos studied no reason was found for subdividing the ventral pancreas into independent right and left parts. Attention was called to the marked differences between the human pancreas and that of the other animals studied. The pancreas of the rabbit and pig usually encircles the portal vein; frequently it does so in the cat, but, apparently, no such occurrence has been re-

corded in man. The probable manner of development of the rare human anomaly in which the pancreas surrounds the intestine, was explained. In addition to the two human embryos modeled, eighteen others were studied. In all of these the dorsal pancreas joined the intestine nearer the stomach than the common bile duct, but in the other mammals this condition was reversed.

Professor F. T. Lewis, in describing the intestinal diverticula of mammalian embryos, cited Osler's tribute in 1881, to Meckel, who wrote of diverticula in 1812. "In the *Handbuch der pathologischen Anatomie* the subject is treated at great length and we have an admirable example of the thoroughness with which the older anatomists did their work. No detail has escaped him, and I doubt if any new point in structure or mode of development has since been determined." Until recently, however, the regular occurrence of epithelial diverticula along the small intestine of mammalian embryos has apparently been overlooked. There may be as many as forty-eight of these in a human embryo of 22 mm. Usually they degenerate, but it is possible that they may persist to form anomalous diverticula in the adult. There is reason to believe that elongated forms may become detached, thus giving rise to mesenteric cysts. The embryonic diverticula are discussed at length in the current number of the *American Journal of Anatomy* (Vol. 7, pp. 505-519).

Dr. John L. Bremer described aberrant roots and branches of the abducent and hypoglossal nerves. In the interval along the ventral portion of the medulla between the roots of the abducent and hypoglossal nerves, nerve roots are found in certain human embryos from the fifth to the tenth week. Of these roots there are two classes: one running ventrally, as though to join the hypoglossal or abducent nerves, or to join the glossopharyngeal nerve, to which no ventral branch has been recognized heretofore; and the other class running laterally, to pass just posterior to the accessory nerve, or, if arising further forward, to pass just posterior to the glossopharyngeal nerve. Roots of this latter class, from their

distribution, seem to represent the fibers which, in a spinal nerve, form the ramus dorsalis. The fibers of both sorts which pass anterior to the vagus seem to indicate the remnants of a ventral root to the glossopharyngeal nerve.

Professor Minot in conclusion spoke of the relations of the new department of comparative anatomy to the general work of the school. The department was organized through the interest of President Eliot, with the intention of broadening the scope of the scientific work in the new buildings, and of cooperating with investigators in anatomy, physiology and pathology. It is expected that it will contribute an essential part to the advanced teaching and research for which the new laboratories are specially designed and endowed. The old department of histology and embryology has been merged with comparative anatomy, to the financial advantage of the school. The chief energy of the new department is devoted to the first-year teaching. The instruction is designed, not to produce specialists in anatomy, but to meet the needs of practitioners in medicine, and to prepare students for their later work in the school. In the fourth year there are courses for specialists both in clinical subjects and in anatomy. The papers read at this meeting indicate the scope and variety of the research work going on in the department.

#### THE AMERICAN MATHEMATICAL SOCIETY

THE one hundred and thirty-eighth regular meeting of the society was held at Columbia University on Saturday, April 25, extending through the usual morning and afternoon sessions. The attendance included thirty-five members. President H. S. White occupied the chair, being relieved at the afternoon session by Professor C. J. Keyser. The following new members were elected: Professor H. E. Buchanan, Lincoln College, Lincoln, Ill.; Mr. E. F. A. Carey, University of California; Professor F. E. Chapman, Southern University, Greensboro, Ala.; Professor R. C. MacLaurin, Columbia University; Mr. E. J. Miles, University of Chicago; Mr. C. A. Stiles, University Preparatory School, Ithaca, N. Y.;

Mr. J. S. Thompson, Mutual Life Insurance Company, New York; Mr. O. A. Turney, Phoenix, Ariz.; Mr. C. B. Walsh, Ethical Culture School, New York; Professor R. T. Wilbur, Christian Brothers College, St. Louis; Miss E. R. Worthington, Yale University. Ten applications for membership were received.

Professor E. B. Van Vleck was reelected a member of the editorial committee of the *Transactions*, to serve until 1911. It was decided to hold the summer meeting and colloquium of the society in 1909 at Princeton University, and Professors Fine, Osgood, Holgate and the secretary were appointed a committee to make appropriate arrangements. A committee consisting of Professors P. F. Smith, Keyser and Bliss was appointed to consider the advisability of holding the annual meeting of the society at Baltimore in affiliation with the American Association for the Advancement of Science.

The following papers were read at this meeting:

S. E. SLOCUM: "The collapse of tubes under external pressure."

E. B. WILSON: "On the differential equations of the equilibrium of an inextensible string."

E. B. WILSON: "On the principle of relativity."

E. SWIFT: "Note on the second variation in an isoperimetric problem."

J. I. HUTCHINSON: "The hypergeometric functions of  $n$  variables."

E. KASNER: "Note on Meusnier's theorem."

B. F. FINKEL: "Determination of the groups of order  $2^m$  which contain self-conjugate cyclic subgroups of order  $2^{m-4}$  and whose generating operations correspond to the partitions  $[m-4, 4]$ ,  $[m-4, 3, 1]$ ."

J. W. YOUNG: "Two-dimensional chains and the classification of complex collineations in a plane."

C. N. MOORE: "On certain constants analogous to Fourier's constants."

P. SAUREL: "On the distance from a point to a surface."

E. B. LYTLE: "Multiple integrals over iterable fields."

P. A. LAMBERT: "The fundamental theorem of algebra."

E. V. HUNTINGTON: "On the fluctuations in the speed of a flywheel."

E. V. HUNTINGTON: "On the theory of the gyro-

scope, with special reference to the Brennan mono-rail car."

O. E. GLENN: "Studies in the theory of degenerate algebraic curves."

The Chicago Section of the society met at Chicago on April 17-18. The summer meeting of the society will be held at the University of Illinois on September 10-11.

F. N. COLE,  
Secretary

#### THE TORREY BOTANICAL CLUB

THE meeting for March 10, 1908, was called to order at the American Museum of Natural History at 8:30 P.M. by the chairman of the program committee. There were twenty-five persons present. The scientific program consisted of an illustrated lecture entitled "On Horseback through Hayti," by Mr. George V. Nash, and was listened to with great interest by all present.

TRACY E. HAZEN,  
Secretary pro tem.

THE meeting of March 25, 1908, was held at the museum of the New York Botanical Garden, with Dr. John Hendley Barnhart in the chair. The minutes of the meetings of February 26 and March 10 were read and approved. A special committee of the club, appointed on February 11, reported as follows:

"At a regular meeting of the Torrey Botanical Club held at the American Museum of Natural History, February 11, 1908, a committee was appointed to draft resolutions concerning the death of the late Morris K. Jesup.

"Be it therefore *Resolved*, That the secretary be instructed to enter in the proceedings of the Torrey Botanical Club, and transmit to the board of trustees of the American Museum of Natural History, this record of our sincere regret at the loss of one who always manifested such a broad and deep interest in all matters pertaining to natural science."

The report of this special committee was unanimously accepted and adopted. The scientific program was then taken up and two papers were read, of which the following abstracts have been furnished by the authors:

*Botanical Experiences in Western South Carolina:* HOMER D. HOUSE.

The richness of the flora of the southern

Allegheny Mountains was commented upon, special attention being called to the beauty of the mountains in early June, when several species of *Azalea* and *Rhododendron* are in bloom. Two trips into the mountains were described, one to Jocassee Valley for *Sherwoodia* (commonly known as *Shortia*) and to Tomassee Knob and Tomassee Falls. At the latter place several northern plants were collected, among others *Viola canadensis*, *Trillium grandiflorum*, *Filix bulbifera* and *Dryopteris Goldiana*. The second trip was to Rabun Bald in Georgia during early June. The top of this mountain is covered with *Rhododendron catawbiense*, which was at that time in full bloom. In the thickets around the coves on the eastern slope of the mountain a new species of bindweed, *Convolvulus sericatus*, was found. *Viola rotundifolia* also was found here, as well as in adjacent South Carolina, thus considerably extending its known range. The speaker exhibited a large number of specimens, several of them new to South Carolina, and commented upon their distribution.

#### *Observations on the Nutrition of Sarracenia:*

WINIFRED J. ROBINSON.

Plants of *Sarracenia purpurea*, the common northern pitcher-plant, were exhibited and several colored illustrations of the plant in flower were shown.

The present series of experiments was undertaken under the direction of Professor William J. Gies at the New York Botanical Garden in the summer and autumn of 1907 to determine the digestive power of *Sarracenia purpurea* on carbohydrates, fats and proteids. Solutions of great difference in concentration were introduced into the pitchers and it was found that they resisted distilled water and 33½ per cent. sugar solution equally well. Acid and alkaline solutions of a very low concentration had no apparent effect upon the pitchers, but a 0.5 per cent. solution of acetic acid and a 1 per cent. solution of potassium nitrate both proved injurious. Sachs's nutrient solution caused the pitchers to decay within a few days. Liebig's meat extract was used as a test of the effect of a stimulant.

Bacteria and infusoria developed in great numbers and decay began in a few days. Solutions of milk in distilled water of different proportions were used, from the results of which it was inferred that the pitcher produced an alkaline substance which reacted with the acid produced in a very dilute solution of milk but was not sufficient to neutralize solutions of greater strength. There was nothing to indicate that the milk fat or protein was digested. Solutions of grape-sugar and cane-sugar of different proportions were placed in the pitchers and there were no indications of a detrimental effect upon them. With Fehling's solution the contents of the pitcher, after the sugar solution had been allowed to remain in them several days, gave a reddish precipitate of copper-oxide, indicating the presence of invert sugar. The reduction was most marked in a 10 per cent. solution of cane-sugar. Starch paste was allowed to remain in the pitchers from three to seven days, when it was removed and tested by boiling with Fehling's solution. The reddish precipitate indicated that a reduction had taken place, though it was not so marked as in the case of the cane-sugar. The addition of an antiseptic did not hinder the reduction of the cane-sugar or starch. Olive-oil and ethyl-butyrate were used to test the fat-digesting power of *Sarracenia*, but the results indicated no digestion. Fibrin was used to determine the digestive power upon protein, but the results were negative. These results as to protein correspond with those obtained by Schimper in 1882 (*Bot. Zeit.* 40: 225) and by Goebel in 1893 (*Pflanz. Biol. Schild.* 2: 186).

MARSHALL A. HOWE,  
*Secretary pro tem.*

#### DISCUSSION AND CORRESPONDENCE

##### VERY HIGH CUMULUS CLOUDS

TO THE EDITOR OF SCIENCE: The conflagration in the city of Chelsea on April 12 caused cumulus clouds to form at a great altitude. At Blue Hill Observatory, situated 14 miles south and 630 feet higher, in the afternoon the temperature was 45° and the relative humidity 14 per cent., with a gale from the west-north-

west. The sky was cloudless, except for a succession of flat, white cumulus which formed at the top of an immense inclined column of smoke that was highest over Boston harbor and about twelve miles from Chelsea. After drifting further to leeward these clouds slowly dissolved as they sank into a warmer stratum, because no longer supported by the rising smoke. Approximate angular measurements made at Blue Hill by Mr. L. A. Wells and in Boston by the writer, when combined with the direction of the smoke, gave the minimum height of these clouds between four and five miles. Their relative velocity as compared with the surface wind also indicated that they were much higher than the ordinary cumulus clouds which float at the level of about a mile.

Artificial conditions gave rise to these clouds, since the air was too dry for the convectional currents at their normal height to cool to the dew-point, even if they had not been broken up by the strong wind. The air, which was intensely heated by the fire, however, maintained its potential excess of temperature over the surrounding air long enough to ascend to so great a height that its small vapor content was condensed into cloud, when it formed not, as is usual, "the visible capital of an invisible column," but the white crown of a brown mountain.

Mr. S. P. Fergusson described in SCIENCE, Vol. X., p. 86, the formation over a fire of similar clouds whose height was also measured from two stations, but in this case the clouds had only half the altitude of those recently observed. In thunder-storms, however, the cumulo-nimbus rise into the cirrus level and their tops have been measured at Blue Hill above eight miles, or nearly twice as high as the cumulus caused by the Chelsea fire.

A. LAWRENCE ROTCH

BLUE HILL METEOROLOGICAL OBSERVATORY,  
April 22, 1908

##### CLOUDS OVER A FIRE

THE great fire in Chelsea, Mass., on Sunday, April 12, 1908, which burned more than two square miles of city blocks, began under conditions of clear sky and high west to north-

west winds. Between two and three o'clock in the afternoon, about three hours after the fire started, the updraft was sufficiently strong to overcome the high wind and occasionally to carry water vapor to the level of cloud formation. Cumulus clouds resulted, capping the smoke, and appearing or disappearing according as the latter rose or failed to rise to the necessary altitude. So near to this altitude was the average summit of the smoke that it was possible for the writer, on seeing an especially vigorous puff from the fire, to predict the formation of a cloud some seconds in advance of its appearance. The clouds did not, as far as could be seen from a position directly to windward of the fire, attain to well-rounded, typical cumulus forms. They varied from mere flecks of white to moderately large but flattish masses and were usually dissipated within five minutes from the time they became visible. Their bases were more or less mingled with and hardly distinguishable from the summit of the smoke-cloud; it was therefore impossible to tell whether or not they were typically flat-based. The clouds appeared to be formed not directly over the fire, but a very considerable distance to leeward, where the high wind first permitted the rising air to reach its dew-point altitude.

The occurrence of these cumuli recalls a similar phenomenon over the burning coal pockets of the Boston & Maine Railroad close by at Charlestown in December, 1896, and noted by Professor R. DeC. Ward in *SCIENCE* for January 8, 1897. In this instance the greater concentration of the fire and the consequent greater proportion of water-vapor carried aloft, caused the development of a far more perfect cumulus cloud than that formed over the widely scattered Chelsea fire.

B. M. VARNEY

HARVARD UNIVERSITY,  
April 30, 1908

#### THE INFALLIBILITY OF NEWTON'S LAW OF RADIATION AT KNOWN TEMPERATURES

ALTHOUGH there is no direct reference to "the absolute temperature of space" (on which hinges the whole question of the sun's *effective* surface temperature) in Professor

Very's paper published in the last number of *SCIENCE*, it is clear that he is still inclined to favor the claim that the temperature of space is in the neighborhood of  $300^{\circ}$  C., notwithstanding the demonstration I have given, showing that the temperature is probably less than  $2^{\circ}$  C.

The title of the present article gives evidence that I wholly disagree with Professor Very when he claims that Stefan's law is in better agreement with actual observation than is Newton's law.

Just why I regard Stefan's law as wholly wrong will appear from the theoretical results given below. How such erroneous laws similar to that of Stefan's ever came to be deduced can be largely inferred from the contents of a paper on "The Earth as a Heat-radiating Planet," sent to the editor of *SCIENCE* on December 25, 1907, but not yet published at the time of this writing.<sup>1</sup> In that paper (where, for obtaining the terrestrial radiation into space, the *effective* surface-temperature of the earth is provisionally placed at  $200^{\circ}$  C.) it is made evident that according to my results "serious changes in the constants of radiation in the formulæ accepted to-day" (to quote part of a sentence from Professor Very's article) must actually be made.

I shall now demonstrate that both theoretically and experimentally *Newton's law gives uniformly consistent results when the observations are properly interpreted*, and that Stefan's law leads to absurd and unintelligible results at known temperatures.

Let us first conceive that the observations were made in free space, the two totally different expressions for the absolute temperature of space will then read

For Newton's law  $t = T(d/D)^2 = 0^{\circ}.7$

For Stefan's law  $t = T \sqrt{d/D} = 300^{\circ}$ .

Since the temperature of space must be taken as constant in each case we obtain for comparison the two sets of values of  $T$ , for different values of  $D$ , given in the second and third columns of the following table:

<sup>1</sup> Published in *SCIENCE* for March 6, 1908.

$\frac{D}{d}$	T Absolute		Newton $T_0 = 300^\circ$
	Newton	Stefan	
1	0.7	300°	300.7
2	2.8	424	302.8
3	6.3	520	306.3
4	11.2	600	311.2
10	70	949	370
20	280	1,342	580
30	630	1,643	930
40	1,120	1,897	1,420
53.4	2,000	2,192	2,300

Considering now, for example, the temperatures corresponding to the values 1 and 2 for  $D/d$ , the total failure of Stefan's law is at once apparent, for while the increase of temperature corresponding to an increase in the aperture from  $D = 0.337$  in. to  $D = 0.674$  in. is consistently  $2^\circ.1$  C. according to Newton's law, the increase according to Stefan's laws is  $124^\circ.0$  C., an absurd result! Again, as the other waves direct from the sun enter and reach the bottom of the earth's atmosphere the focal temperature due to these *direct* waves must evidently be measured from a totally different starting-point. If the absolute temperature of air at the place of observation is  $T_0$ , then  $T_0$  must be taken as the origin from which the temperatures, properly belonging to the *direct* solar radiations alone, must be measured. If for the present case we have  $T_0 = 300^\circ$  C., the theoretical values given in the fourth column will result from Newton's law. Now when we come to apply this same line of reasoning to Stefan's law, the data given in the third column become both absurd and unintelligible for ordinary temperatures (corresponding to small values of  $D$ )!

Much of the confusion heretofore existing regarding the temperature of space can, in my opinion, also be traced to the largely prevalent but mistaken idea that the ordinary mercurial thermometer is a suitable instrument for measuring *direct* radiations, when in fact this thermometer then simply measures the stored-up energy trapped in the "hot-house"-like form of this particular instrument. The ideal thermometer will be one which gives instantaneous results, since the intensity of the

ether vibration is independent of the time. For this reason the platinum plate in my observations was hammered so thin that the evidence of melting was secured from practically instantaneous exposures in the solar focus. It will be noticed that for the value 53.4, corresponding to  $D = 18$  inches, I have assumed the actually measured focal temperature to be  $2,300^\circ$  C.; the excess over the accepted value for the temperature of melting platinum I have roughly estimated to be equal to the losses resulting from causes similar to those which Professor Very mentions in the second paragraph of his paper.

In any case, I hold that however great the possible error of my measured value for the focal temperature may be, this error can not affect the validity of my theoretical formulas.

J. M. SCHAEFERLE

ANN ARBOR, MICH.,

February 17, 1908

#### SPECIAL ARTICLES

##### THE HEREDITY OF SEX

IN *Proceedings of the Zoological Society*, 1906, I., p. 125, Doncaster and Raynor described certain remarkable experiments respecting the inheritance of the moth *Abraxas grossulariata* and its variety *lacticolor*. This variety was originally known in the female form only. Experimental crossings showed the following results:

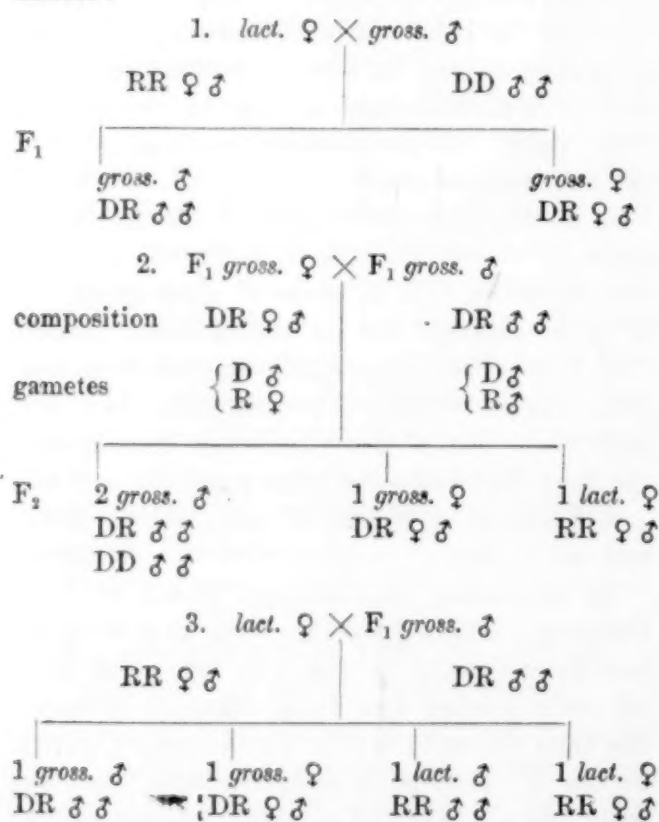
1. *Lact.* ♀ × *gross.* ♂ gave  $F_1$  ♂s and ♀s all *gross.*
2.  $F_1$  *gross.* ♀ ×  $F_1$  *gross.* ♂ gave *gross.* ♂s, *gross.* ♀s and *lact.* ♀s; no *lact.* ♂ being formed.
3. *Lact.* ♀ ×  $F_1$  *gross.* ♂ gave all four possible forms, *gross.* ♂s, *gross.* ♀s, *lact.* ♂s, *lact.* ♀s. The ♂ *lacticolor* thus raised were the first that had ever been seen.
4.  $F_1$  *gross.* ♀ × *lact.* ♂ gave all ♂s *gross.* and all ♀s *lact.*

In discussing this curious series of facts Doncaster adopted Castle's view that each sex was heterozygous in sex, and that each gives off male-bearing and female-bearing gametes. He then shows that if it be assumed (1) that in the  $F_1$  ♀ there is coupling such that the male ova all bear the *grossulariata* factor and the female ova all bear *lacticolor*; (2) that in

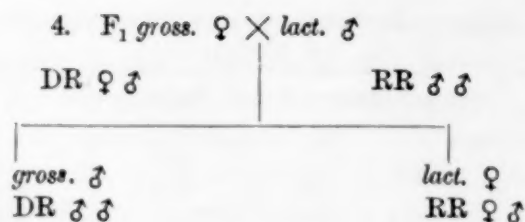
the gametes of the male there is no coupling; (3) that in fertilization union can only take place between gametes bearing opposite sexes; (4) that dominance attaches to the sex brought in by the ovum; the observed results would be produced.

On reexamination of the case we have found a much simpler and, as we think, more probable account of the phenomena. Two assumptions only are needed: (1) that one female is heterozygous for sex, femaleness being dominant, and the male a homozygous recessive; (2) that when in  $F_1$  the two dominants, femaleness and the *grossulariata* factor coexist, there is a repulsion between them, such that each gamete takes one or other of these two factors, not both. Such mutual repulsion of two dominants has already been shown to occur in the sweet pea when a plant is heterozygous for the upright standard and for the blue factor, constituting what must be regarded as a spurious allelomorphism between them.<sup>1</sup>

The whole series of facts is then consistently represented as follows, D and R representing the presence and absence of the *grossulariata* factor:



<sup>1</sup> SCIENCE, N. S., XXVI., p. 655.



The numbers originally obtained were very wild and irregular, but on repeating the experiments Doncaster got results which are numerically very close to expectation.<sup>2</sup>

Attention is drawn to this case as illustrating the great value of evidence respecting dissimilarity in reciprocal crosses for the elucidation of the problem of sex-heredity. We have long been engaged on a more complex case of this kind, the heredity of the black pigmentation of the Silky fowl, in its crosses with brown Leghorns and other fowls with light shanks. The facts there also point very clearly to a similar solution, but it may be some years before the evidence is complete.

On general grounds it seems to us probable that one and not both sexes of the same organism will be shown to be heterozygous for sex, and that the approximately equal output of the two sexes in ordinary cases is a consequence of this. Correns<sup>3</sup> has lately shown that his experiments with *Bryonia* suggest that in that plant it is the male which is heterozygous. Russo<sup>4</sup> from his experiments

<sup>2</sup> Nature, 1907, LXXVI., p. 248.

<sup>3</sup> Bestimmung und Vererbung des Geschlechtes, Borntraeger, 1907.

<sup>4</sup> Atti Ac. Lincei, 1907. Heape (*Proc. Roy. Soc.*, Vol. 76, B, 1905) described in the rabbit processes by which ovarian ova frequently degenerate, apparently as a normal occurrence. Mr. Heape very kindly gave us an opportunity of examining his preparations, and it was impossible to avoid being impressed with the general resemblance which such degenerating ova bore to those which Russo regards as destined to become males. Consequently before that view of their nature is adopted, the relation of the so-called "male" ova to the degenerating ova will need very careful study; for it seems as yet not unlikely that those differences which Russo has taken to indicate maleness may prove to be due to incipient degeneration. Also as regards the important question of the alleged effect of lecithin in increasing

on rabbits concludes that sex is determined by the ova, which he regards as male and female, respectively, or in Mendelian terminology, that it is the female which is heterozygous.

There is, we think, no reason *a priori* why in nature generally dominance should be the special property of one sex alone. We rather anticipate that dissimilarity will be found between the great groups in this respect.

Consistently with the view that in Vertebrata the female is heterozygous, the production of male secondary sexual characters ensues in the female consequent on ovarian disease, while castration of the male produces effects which may perhaps all be regarded as arrests of development. In the Crustacea, however, the work of Geoffréy Smith and of Potts on parasitic castration points to the converse conclusion, namely, that the male is there heterozygous for sex, assuming definite female characters when castrated, while in the female castration merely arrests development.

Correns refers to E. B. Wilson's facts respecting the accessory chromosome as supporting the view that the male is the heterozygous sex, and we have lately done the same.<sup>\*</sup> Doncaster, however, has pointed out to us what must be a serious difficulty in the application of this argument; for if the male sex be dominant, it has then to be supposed that dominance attaches not to the presence of the accessory chromosome, but to its absence, since it is in the female that the accessory chromosome is paired. Great weight we think must be given to this criticism. Dominance, as we now suppose, is due to the *presence* of something which is *absent* from the recessive, and we are almost precluded from imagining that the absence of a chromosome can be a cause of the dominant quality.

In order to bring the facts of sex inheritance in the parthenogenetic forms (bee, aphid)

the output of females, an opinion can scarcely be formed on the cases published by Russo, for these are declared to have been selected. It is to be hoped that the full statistics will soon be published.

<sup>\*</sup> SCIENCE, XXVI., 1907, p. 658.

into line with our view, it would perhaps have to be supposed that sex segregation in these types takes place not between gametes, but between the primitive soma and the germ plasm, so that the ova would all bear the recessive male character and the spermatozoa the dominant female factor. To discuss this suggestion in detail would, however, carry us beyond the scope of this note.

R. C. PUNNETT

W. BATESON

CAMBRIDGE, ENGLAND,

March 19, 1908

#### PRE-CAMBRIAN ROCKS IN SOUTHEASTERN WYOMING<sup>1</sup>

DURING the past summer the ancient rocks of the Laramie and Sherman quadrangles in southeastern Wyoming were studied in some detail. The maps cover a portion of the Laramie Mountains and the easternmost spurs of the Medicine Bow range. It appears that most of the region is underlain by a coarse-grained red granite, but there are scattered patches of older rocks which show various degrees of metamorphism and bear complex relations to one another.

The oldest rocks recognized in the district are a series of schists and gneisses, which are largely metamorphosed volcanics, although they contain some rocks clearly of sedimentary origin, and others which are doubtful. The supposed volcanics include hornblende schists and schistose rhyolites. Some occur in the form of dikes, while breccias indicative of surface extrusives were recognized in several places. Certain highly quartzose rocks and tremolite-schist are interpreted as altered sediments. The rocks are so highly folded, metamorphosed and cut by later intrusions that the relations of the different members to each other are very obscure and have not yet been elaborated.

Next in age follows a group of granitic gneisses, which are evidently metamorphosed granites. They are clearly intruded into the schists just mentioned. There are at least two distinct varieties of these gneisses: one

<sup>1</sup> Published by permission of the Director of the U. S. Geological Survey.

a coarse-grained gray-to-pink biotite-gneiss and the other a highly acid pink muscovite-gneiss of finer texture. The latter was found intruded into the former.

A variant group of semi-metamorphosed basic intrusives is somewhat younger than the gneisses. These include syenites, gabroid and dioritic rocks. In some of these rocks a gneissic structure has been induced, while others are not notably altered. It is evident that they are of different ages relatively to each other, although belonging to the same general interval of time in the section.

In the northern part of the Sherman quadrangle gray anorthosite, or labradorite rock (with or without hornblende), is exposed over wide areas. It is intruded into the schists, granite-gneiss and dioritic rocks, but is itself essentially unaltered.

On the east side of the district the gneisses are further intruded by a quartz-porphyry, which is so little altered that it is believed to be younger than the basic intrusions, although it may be older than the anorthosite.

All of the foregoing formations are surrounded and probably underlain by the great mass of coarse red granite, to which the name "Sherman granite" has been given. The contact surface is in many places so nearly horizontal that bodies of gneiss and schist form outliers on hill-tops, while the valleys have been trenched through into the younger granite. Dikes of all sizes emanate from this foundation and traverse gneisses, schists, porphyries and gabbros indiscriminately. The granite itself is essentially unaltered, except that it is deeply weathered at the surface. It is crossed by a moderate number of small dikes, consisting of fine-grained granite, pegmatite and diabase. The diabases are apparently the youngest rocks of the pre-Cambrian complex.

Since there are no well-defined sedimentary rocks in the pre-Cambrian mass, it is not possible to assign the rocks to any particular age. They are covered unconformably by the Carboniferous, but they are so nearly identical with granites and older rocks, which to the north in the Big Horn Mountains and to the south in Colorado lie beneath the Cambrian,

that the writer has no hesitation in considering them all to be of pre-Cambrian age. It is probable that the schistose complex of volcanics and intrusives, with traces of sedimentary rocks, belongs to the Archean; it is equally probable that the unaltered granites and diabase are not older than the Algonkian. The position of the intermediate formations is entirely problematical.

ELIOT BLACKWELDER

UNIVERSITY OF WISCONSIN

#### A STATISTICAL STUDY OF BROWN SCALE PARASITISM

PARASITIC and predatory enemies are important factors that should be taken into consideration in the control of injurious insects; but the effectiveness of such agencies is very often overestimated, since their efficiency is usually based on estimates made instead of upon accurate and sufficient data. It very frequently happens that a notable decrease in numbers of insects occurs coincidentally with the introduction of a parasite, but this reduction should not be attributed to the parasite alone, as is often the case, since there are many other factors entering into the problem.

The brown scale (*Eulecanium armeniicum* Craw) is one of the most important pests of prune trees occurring in this state, and according to statements frequently made and published here, this scale is kept in very complete subjection by its parasite (*Comys fusca*). This control for the whole state is usually estimated at 95 per cent. During the past winter the writer visited sixty-six different orchards, covering all the important prune sections in the state, and has made an examination of a total of 63,700 scales. From this count the actual percentage of parasitized scales is 12.02 per cent. The counts were made in units of 100 and covered various parts of the tree and various trees in the orchard. The location of each orchard and the name of its owner were taken, and the abundance of scales, both young and adult, in relation to the amount of parasitism, was noted. A summary of a part of these data is given in the table below:

No. Orchards	Scales Examined	Parasitized	Not Parasitized	Per Cent. Parasitized	Per Cent. Not Parasitized	Highest Per Cent. in Any Orchard	Lowest Per Cent. in Any Orchard	Greatest Number Parasitized in 100	Least Number Parasitized in 100
27	31,200	1,918	San Joaquin Valley 29,282	6.15	93.85	32.25	1.9	45	0
11	14,500	1,916	Sacramento Valley 12,584	13.21	86.79	23.15	2.38	60	0
10	4,800	644	Santa Clara Valley 4,156	13.42	86.58	20.5	4.5	23	3
9	7,200	971	Napa Valley 6,229	13.49	85.51	17	11	22	7
9	6,000	2,210	Sonoma Valley 3,790	36.83	63.17	47.6	20.33	55	15
66	63,700	7,659	Grand Total California 56,041	12.02	87.98	47.6	1.9	60	0

H. J. QUAYLE

UNIVERSITY OF CALIFORNIA,  
BERKELEY

## EXPERIMENTS ON EARTH CURVATURE

AFTER reading my article on earth curvature<sup>1</sup> Mr. H. F. Dunham, of New York, called my attention to similar experiments reported

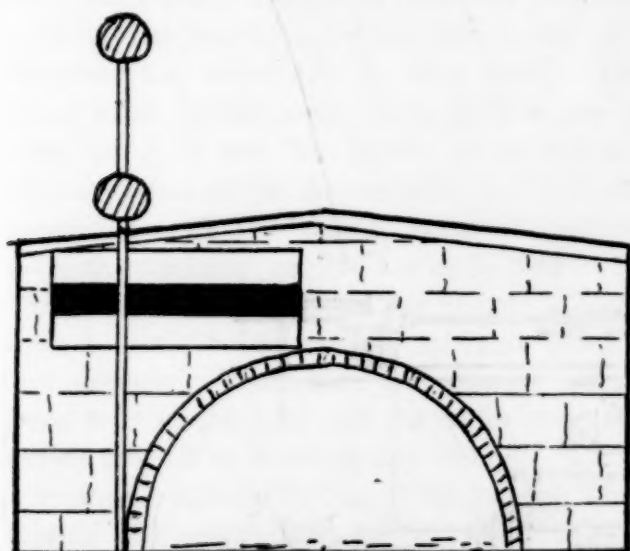


FIG. 1

by Mr. Alfred Russel Wallace.<sup>2</sup> A brief sketch of Wallace's experiment and its results

<sup>1</sup> "A Simple Method of Proving that the Earth is Round," *Nat. Geog. Mag.*, XVIII., 771.

<sup>2</sup> "My Life," Alfred Russel Wallace, Vol. II., 381-393.

may possibly be of interest to the readers of SCIENCE.

In 1870, through the medium of the public press, a Mr. John Hampden wagered £500 that the convexity of the surface of any inland water could not be proved. Mr. Wallace accepted the challenge. The old Bedford Canal was chosen for the experiment and a six-mile stretch between two bridges selected as the site. On the higher of the two bridges a white sheet, six feet long and three feet wide, was fastened. Along the center of the sheet parallel to the water was a six-inch black band, the lower edge of which was at the same height above the water as the parapet of the second bridge. At the half-way point a pole with two red discs, four feet apart, was erected in such a way that the center of the upper disc was at the same height as the center of the black band. A six-inch telescope, resting on the parapet of the second bridge, was used for sighting. The result, as seen through the telescope, is shown in the accompanying figure. A second experiment was performed with a spirit-level.

The sequel of the experiment is almost as interesting as the experiment. The referee for Mr. Hampden, a devotee of the flat earth school, insisted, on looking through the telescope, that the three points were in a straight line. Hampden, who refused to look through the instrument, accepted the statement, although Wallace's referee declared that the curvature was shown. An umpire, chosen to settle the difficulty, awarded the money to Wallace. Then followed a remarkable series of libels, persecutions and recriminations. As late as 1885 Hampden published, among other things, the statement that "no one but a degraded swindler has dared to make a fraudulent attempt to support the globular theory." Wallace sums up his experience in this matter thus: "... two law suits, the four prosecutions for libel, the payments and costs of the settlements amounting to considerably more than the £500 pounds I received from Hampden, besides which I bore all the costs of the week's experiments, and between fifteen and twenty years of continued persecution."

The whole story as presented by Wallace is

a most astounding series of libels, against which he seemed to have been utterly powerless.

ROBERT M. BROWN

STATE NORMAL SCHOOL,  
WORCESTER, MASS.

A SIMPLE CONTINUOUS ELECTRIC CALORIMETER  
FOR STUDENTS' USE

For several years we have been using, with considerable success, a simple form of the continuous-flow calorimeter for measuring Joule's equivalent in the electrical laboratory work of our elementary students. I venture to describe the apparatus here in the hope that it may commend itself to those engaged in practical work, as being simpler of operation than the older electrical methods of measuring this important constant.

A glass tube, about 50 cm. long and 2 to 3 mm. internal diameter, is cemented at both ends to brass collars carrying washers and

mix the water as it flows through. A copper or tin vessel with overflow maintains a constant head of water from the city mains at any desired elevation, and a tube conveys the water to the inflow end of the calorimeter. An air trap, made from an inverted thistle tube, serves to catch any air bubbles liberated or carried down by the water. The temperature of the inflowing water is measured on the thermometer. After passing through the flow tube, the water passes out at the outflow end to a suitable measuring vessel. The temperature of the outflowing water is recorded at regular intervals on the second thermometer. The upper end of the brass T, to which the outflow pipe is attached, is open to the air and establishes the head independent of the exact level of the end of the outflow pipe. Having obtained a reading on the two thermometers before any heating current is turned on, the electrical circuit is completed, and after four or five minutes, during which the temperature of the outflow water becomes

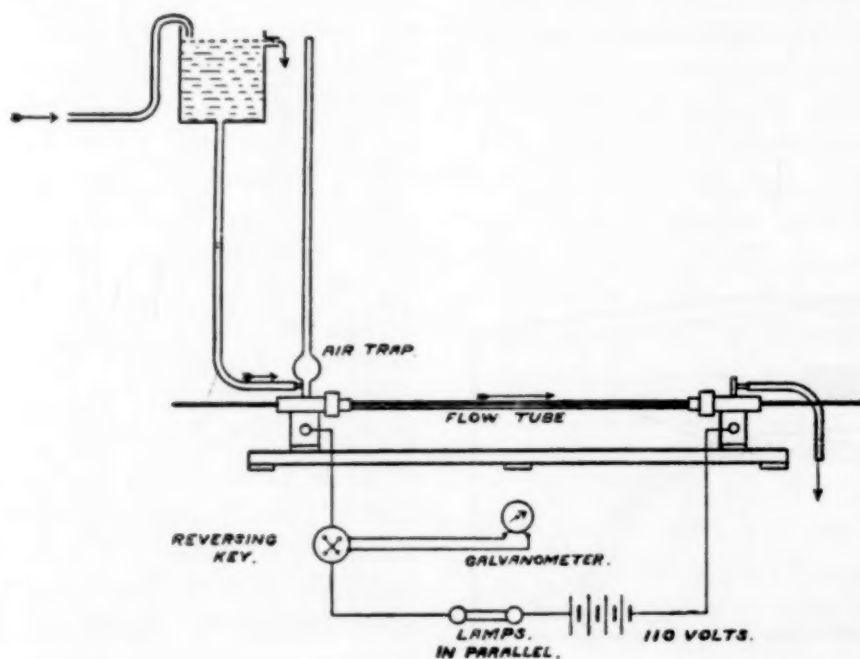


FIG. 1

nuts, which screw into brass castings drilled out to receive suitable thermometers. A heating wire, of about 10 ohms, coiled in a long helix, passes through the tube and is soldered to the brass collars. The helix serves to break up the stream-lines, and thoroughly

steady, readings are commenced. These consist in measuring the current at regular intervals on a tangent galvanometer or a Weston ammeter and reading the inflow and outflow temperatures during the time taken to obtain a suitable amount of water to weigh,

or during the time necessary to fill a vessel of known capacity. From these readings the average flow per second and the difference in temperature can be determined and hence the number of calories of heat carried off by the water per second calculated. Knowing the electric current and the resistance of the heating wire, the electrical energy in Watt seconds can be calculated and the ratio of this to the heat produced gives the value of  $J$ . In place of knowing the resistance of the heating wire, the drop across the calorimeter may be obtained on a voltmeter. In our work the ordinary 110-volt direct-current circuit is used through a number of lamps, which may be connected either alone or in parallel. Various experiments may be performed with different flows and different heating currents. An alternating heating current may be equally well employed when a suitable A.C. ammeter or dynamometer is introduced.

The value of the method lies in its directness and great simplicity. No corrections are necessary for heat loss, provided the mean temperature of the flow water does not differ more than about 5 degrees from the temperature of the room, and even for larger differences the correction is very small. The object of the experiment, which is the measurement of  $J$ , is not lost sight of by the elementary student in determining troublesome corrections. A few values, taken at random from the students' results, are as follows: 4.16, 4.20, 4.12, 4.25, 4.18 joules per calorie. These were obtained with heating currents from 2 to 4 amperes. The rise of temperature ranged from 6 to 12 degrees, and the water flow was varied from 2 to 4 grams per second.

Professor Ervin S. Ferry, of Purdue University, LaFayette, Ind., writes me of the success attending the use of the calorimeter in his elementary classes. He has included an account of the apparatus and method in his recent text-book of "Practical Physics," Vol. 1. The accompanying diagram shows the general plan of the apparatus and connections.

H. T. BARNES

MCGILL UNIVERSITY

#### EVOLUTION IN RHYME

A LITTLE book has recently come into my hands that may be as new to most of the readers of SCIENCE as it is to me. It is called "Das Neue Laienbrevier des Haeckelismus," is in two parts, was published in 1878 in Berne and Leipzig, and evidently enjoyed a considerable popularity in its day, as the first part is marked, "3te Auflage." The first part is called "Genesis, oder die Entwicklung des Menschengeschlechts, nach Haeckel's Anthropogenie in zierliche Reimlein gebracht," while the second is "Exodus, oder der Auszug des Menschengeschlechts aus Lemurien, eine kritisch-analytische Komödie." The author is one Herr Reymond, and the very effective comic illustrations are by Steub, a one-time popular contributor to *Fliegende Blätter*.

The book is a burlesque in rhyme of the descent of man, and is introduced by a short statement of the history and status of the theory of organic evolution and an abstract and general table of contents of Haeckel's "Anthropogenie." The parts of the Laienbrevier are arranged exactly according to the chapters and titles of the "Anthropogenie," and the whole extremely clever *tour de force* must have been received with great glee by the anti-evolutionists, especially the anti-Haeckelians.

The contents of the book are arranged in the general form of a play with the *dramatis personæ* speaking rhymed dialogue and introducing many songs in solo or chorus, the melodies for these songs being mostly well known folk, soldier, and especially student songs. There are so many clever verses and the whole performance is so well sustained throughout the two volumes (the second was only written in response to the popular acclamation of the first) that in selecting a couple of sets of verses to illustrate the character of the Laienbrevier I have made no attempt at particular choice but have taken practically the first to attract my attention. Dissociated, however, from the well-organized total performance they give but little more than a suggestion of the entertaining character of this delightful bit of evolution literature. I

tender profuse apologies for my awkwardness in translating Herr Reymond's verses. Rhyme and rhythm are very much out of my line.

On page 119 of the first volume in the section "Vom Moner bis zur Gastraëa," Moner sings, to the melody of "Ich bin der alte Ahasver;

I am an ancient Moneron,  
Derived by chance from carbon;  
Dredged up from darkest of deep seas  
To pose with science' garb on.

I am an ancient Moneron,  
All organs sadly lacking;  
No eyes or ears nor limber tongue  
To keep forever clacking.

I am an ancient Moneron  
Given o'er to multiplying.  
O, would I had some power beside,  
E'en were it that of dying!

And then Amœba comes forward and sings, to the tune of "'S ist kein schöner Leben als Studentenleben."

O, what a happy family  
Are we minute Amœbæ!  
In stagnant pools and slimy wells  
We lay our courses creepy.

When we divide, we must endure  
A protoplasmic spasm,  
For unlike Moneron we have  
A nucleus; quite a chasm!  
Yet still we lack what we should like,  
Our lowly life to aid in,  
For each a kindly-hearted, fair  
And true Amœba-maiden!

And so on for a score more of lines, ending with "Das Amœbenthum, es lebe hoch!"

At the end of the second volume a picture is given of the old theater *Diener* sweeping out the broken and used up properties of the play, and soliloquizing thus, as epilogue:

Completed is the comedy;  
The actors pass, to no one's sorrow;  
The old world stands in its same place,  
And other prophets come to-morrow.

VERNON L. KELLOGG

STANFORD UNIVERSITY, CAL.

#### A CORAL ISLAND MODEL

It is announced in the *Harvard University Gazette* that a large naturalistic model of

Bora Bora, one of the Society Islands in the South Pacific Ocean, has recently been added to the exhibits in the coral room of the Museum of Comparative Zoology. The model is the gift of Mr. Alexander Agassiz and the work of Mr. George C. Curtis, whose model of the metropolitan district around Boston, in another room, is already well known to visitors to the museum. Mr. Curtis visited Bora Bora in 1904, at the suggestion of Mr. Agassiz, and spent several months there making surveys, soundings, photographs, and sketches, the results of which are now shown in the model. It is on a scale of about one and a half feet to a mile, horizontal and vertical alike, and is painted in natural colors. The central island, peopled by about 2,000 native Polynesians, is about five by three miles in diameter. It is the dissected upper portion of a great volcanic cone that here rises from the deep sea floor; a steep-walled central knob standing about 2,500 feet over sea level, and surmounting a group of radiating spurs. The foot of the heavily wooded lower slopes is lapped by the quiet waters of the lagoon, where the blue water is some fifty fathoms deep. Communication with the sea is maintained by a passage through the outlying shoals and the narrow barrier reef which forms the exterior border of the concentric island system. A little farther out the sea bottom deepens rapidly at an angle of nearly 45 degrees, and thus soon descends to a depth of 2,000 fathoms or more. The deep ocean floor would, on the scale of the model, be reached near the level of the floor of the coral room. The ocean depths immediately surrounding the reef are well suggested by the dark blue color of the outer submarine slope and by the device of placing models of vessels at sea level on fine wire supports which are hardly visible a few feet away. The use of natural colors and true proportions throughout the model makes it highly effective. By placing the eye at sea level a most realistic view of the island may be gained; the line of breakers on the outer barrier reef; the sails of boats in the lagoon, their hulls hidden by groves of palm trees; the villages at the foot

of the inner mountainous island; the lower wooded slopes; and, dominating all, the central, gray-white peak.

#### WORK OF THE COAST AND GEODETIC SURVEY

THE report itself must be consulted for the details of the extensive cartographic work of the Bureau in the United States proper, Alaska, Porto Rico and the Philippines, as well as for the account of the progress of the primary triangulation and leveling of precision. In all these branches of the work great activity prevailed and notable results were achieved during the year.

Certain important work of the survey receives bare mention, as for instance the results of the investigation of the earth's figure based on geodetic operations in the United States. This is owing to the fact that these results were communicated to the International Geodetic Association in a preliminary report which has been published.

Appendix 1 gives the details of field operations, and Appendix 2, the details of office work. Five other appendixes form valuable discussions of interesting subjects.

Soon after the California earthquake of April 18, 1906, it became evident that the permanent horizontal displacements of large areas covered by triangulation in California had so changed the lengths and directions of the lines joining the triangulation stations as greatly to diminish the value of the triangulation for its primary purposes as a framework for future surveys. During the year, therefore, new triangulation extending from Point Arena to stations south of Monterey Bay was done, which serves to restore the value of the old triangulation by determining the new positions of 61 of the old triangulation stations. The triangulation included the Farallan Light House, 22 miles to the westward of the great fault accompanying the earthquake, and the stations Mocho and Mount Diablo, 33 miles to the eastward of the fault. The new triangulation serves to trace the permanent distortions and displacements of the earth's crust for many miles

back from the fault in each direction and to show that they follow certain regular laws. This is the most extensive and accurate determination by triangulation of the effects of an earthquake which has yet been made anywhere in the world. Appendix 3 is a full report upon this investigation.

A full report on the measurement of six primary bases with steel and invar tapes in 1906 is printed as Appendix 4. The invar (nickel steel) tapes have a coefficient of expansion about one twenty-eighth that of steel tapes, hence it is much less difficult to keep the temperature errors within the required limit with invar tapes than with steel tapes. Invar tapes had not been used in the United States until 1906 in primary base measurements. The thorough tests of these tapes, made by using them on six bases in conjunction with the steel tapes formerly used, showed that measurements may be made more conveniently, accurately, and at smaller cost per mile than with the steel tapes, and that the invar tapes are sufficiently durable and stable for safe field use. This demonstration is believed to be a distinct step in advance in base measurement.

The steady progress in the magnetic survey of the United States and accumulation of magnetic observational data, as mentioned in Appendix 5 of the report, should be of special interest to the surveyor and the navigator, as well as to those pursuing the study of the science of terrestrial magnetism. Throughout the year the measurements of the earth's magnetism were made at places distributed over a majority of the states and territories of the United States and at numerous places at sea along the Atlantic and Pacific coasts of North and South America, and in Porto Rico and the Philippines. Important information was secured in the equatorial regions. Numerous "repeat" observations were made throughout the country in order to follow as closely as possible the secular change in the magnetic elements. Five magnetic observatories were maintained in continuous operation and important seismological data were also obtained. The facilities of the

observatories were afforded to all investigators who desired to make standardization comparisons of their instruments; and in response to numerous requests information, or observational data, was furnished for practical application or for use in special investigations of terrestrial magnetism and allied phenomena.

Appendix No. 6, constituting the concluding portion of a manual of tides, treats of the flow of water, of river tides, tidal currents, permanent currents, annual inequality, lake tides, seiches, and miscellaneous tidal matters.

Charts of concurrent lines are given for the principal marginal waters along the Atlantic Coast of the United States. The numbers upon these lines show the times of the maximum flood current.

The dependence of the permanent ocean currents and the annual height in equality upon the prevailing winds is briefly pointed out. Seiches are shown to exist in harbors and other tongues of water, as well as in lakes; but their character is fundamentally different in some respects.

The analyses of observations upon the tides of Lake Superior show that they follow closely the equilibrium theory although the range is only  $1\frac{1}{2}$  inches at Duluth and one third inch at Marquette.

In Appendix No. 7 is given a detailed description with appropriate illustrations of the Long Wire Drag, a device for detecting erratic obstructions of small extent in navigable waters. The method of operating can be understood from the simple statement that the drag is a wire varying in length from 480 to 1,400 feet, supported at suitable intervals and maintained at any desired depth below the surface of the water. This drag is towed over any given area by launches, and in the area so searched no elevation of the bottom above the depth at which the wire is suspended can escape detection. Buoys floating at regular intervals above the drag indicate to observers in the launches when and where an obstruction is touched, and the spot so indicated is then accurately determined.

This method of sweeping has proved a sure means of detecting pinnacle rocks and similar erratic obstructions which heretofore have

eluded the hydrographic surveyor, since it is almost impossible to discover them by lines of soundings with the lead. Only the navigator in whose hands rest many lives and much property can realize the relief from mental strain that comes from knowing that the water in which he is sailing is absolutely free from hidden dangers or that every menace is charted. The device has proved very satisfactory under widely varying conditions and marks a decided advance in marine surveying.

This report, or any one of the Appendices, numbered 3 to 7, may be obtained by interested persons, free of charge, upon application to the Superintendent of the Coast and Geodetic Survey, Washington, D. C.

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#### BERMUDA BIOLOGICAL STATION FOR RESEARCH

By arrangement with the Bermuda Natural History Society, the Station for Research at Agar's Island will be open for about seven weeks this summer. There are accommodations for a limited number of instructors or research students in either zoology or botany.

Members of the expedition will sail from New York on the steamer *Bermudian* (Quebec Steamship Co.) at 11 A.M., on Tuesday, June 16, arriving in Bermuda, June 18, and will return on August 5, reaching New York August 7. Those who can not sail on June 16, may do so two weeks later, June 30.

The expense will be \$110 for first-class passage from New York to Bermuda and return, and for board and lodging at the islands six weeks and six days. For the shorter time—four weeks and six days—the expense will be \$90. Payments are to be made to the undersigned, fifty dollars on or before June 1, the balance on arriving in Bermuda.

For further information apply to

E. L. MARK

109 IRVING STREET,  
CAMBRIDGE, MASS.

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#### CONFERENCE ON THE CONSERVATION OF NATURAL RESOURCES

In a sense the federal and state scientific work to date culminates in the Conference on

the Conservation of Natural Resources, in the White House, May 13-15. Through the operation of state and federal geological surveys, supplemented by collateral research in higher institutions of learning, the extent of coal, iron ore, and other mineral deposits, in all parts of the United States has been determined or estimated with a fair degree of accuracy; so that it is now possible to say that the original stock of coal of fairly high grade was somewhere in the neighborhood of 2,000,000,000,000 tons, and the original stock of readily workable iron ore approximately 10,000,000,000 tons—while the rates of consumption and waste also are fairly known. Through the operations of the federal forest service, with the aid of antecedent agencies and state bureaus, the rates of forest growth and consumption and destruction have been ascertained with a fair degree of accuracy; so that it is possible to estimate the duration of the timber supply of the country. Through the operations of the U. S. Weather Bureau, with antecedent agencies, the quantity and distribution of rainfall, on which the habitability of the country depends, has been measured approximately; so that the capability for development of different sections of the country is known in at least a general way. Through the operations of the Bureau of Soils, with antecedent and adjunct agencies, the crop producing capacity of the different sections of the country, together with the benefits of improved cultivation and the losses through soil-erosion, have been ascertained in at least a preliminary way; while contemporary bureaus in the federal Department of Agriculture and numerous state instrumentalities have indicated the leading principles involved in that crop production on which national prosperity primarily depends. Thus the state and federal work to date has served to establish the nature, and in some measure the extent of the natural resources of the country.

Through the operations of scientific agencies the habit of definite thought has become fixed; so that experts habitually think and speak or write in quantitative terms. In

earlier years a coal deposit, or iron ore body, or pine forest, was vaguely thought inexhaustible; of late the first duty of the expert is to estimate the quantity, the rate of production and the duration of the supply. The habit of definite thought in terms of quantity is now extending to soil, to water-supply, to productivity of the land in forests or other crops, and with this extension there has arisen a realization that none of the natural resources of the country can be considered illimitable or inexhaustible, and that all should be viewed as national assets, to be guarded in the interests of the country.

In connection with the assembling of facts and the development of definite thought (which are among the immediate results of scientific work), the habit and the faculty of prevision have grown up. Prevision has aptly been styled the essential factor of science; and its growth throughout the country as the result first of observation and then of definite arrangement of the facts relating to resources can only be regarded as a typical illustration of the scientific method, notable especially for its magnitude—extending as it does virtually to an entire people.

The natural outcome is the idea of conservation as a public duty, which originated chiefly in the forest service and the geological survey; and it is significant that the idea has taken form more or less independently also in the minds not only of scientific men, including engineering and other experts, but also in the minds of statesmen in every part of the country. President Roosevelt was early impressed; Secretaries Wilson and Garfield were soon in sympathy; and when the president and a score of governors met on the Mississippi last October, it was found that a number of the state executives had fully grasped the same idea. The plan for the Conference, first definitely suggested by the Inland Waterways Commission, was announced by the President at Memphis, October 4; and the interest has steadily increased. The four great engineering associations have contributed effectively by separate and joint meetings; and commercial and

civic organizations have been active, as have been a number of scientific bodies, beginning with the American Association for the Advancement of Science, which appointed a strong committee at the Chicago meeting, and whose president is a leading speaker at the conference.

The conferees with the president include the governors of the states and territories, each with three advisors; the justices of the Supreme Court; the members of the Cabinet; the senators and representatives in the Sixtieth Congress; the Inland Waterways Commission; the presidents of leading national and interstate scientific, technical and industrial organizations dealing with natural resources; together with a limited number of special guests, representatives of the press, etc.

While no formal program was framed in advance, the preliminary calendar was as follows:

#### CALENDAR

May 12, 7:30 P.M.—Meeting of the Governors and special guests with the President at dinner in the White House.

May 13, 10:00 A.M.—Assembling of Governors and their advisors with other conferees in the East Room.

11:00 A.M.—Address by the President: "Conservation as a National Duty."

2:30 P.M.—Session on Mineral Resources.

Opening statements:

"The Conservation of Ores and Related Minerals," by Andrew Carnegie.

"The Waste of Our Fuel Resources," by Dr. I. C. White.

General discussion—opened by John Mitchell.

7:30 P.M.—Meeting of the President and Governors as Guests of the Washington Board of Trade at dinner in the New Willard Hotel.

May 14, 10:00 A.M.—Session on Land Resources.

Opening statements:

"The Natural Wealth of the Land and its Conservation," by James J. Hill.

"Soil Wastage," by Professor T. C. Chamberlin.

"Forest Conservation," by R. A. Long.

"Conservation of Life and Health by Improved Water Supply," by Dr. George M. Kober.

General discussion.

2:30 P.M.—Session on Land Resources.

Opening statements:

"Interdependence of Resources, Illustrated by California's Rivers and Forests," by Ex-Governor George C. Pardee.

"Grazing and Stock Raising," by Hon. H. A. Jastro.

General discussion.

9:00 P.M.—Reception to meet the Governors and the Inland Waterways Commission at the residence of Mr. Gifford Pinchot.

May 15, 10:00 A.M.—Session on Water Resources.

Opening statements:

"The Public Lands and Land Tenure," by Ex-Senator Joseph M. Carey.

"Navigation Resources of American Waterways," by Professor Emory R. Johnson.

"The Conservation of Power Resources," by H. S. Putnam.

General discussion.

2:30 P.M.—General Session.

4:30 P.M.—General meeting of the conferees with ladies accompanying them, as guests of Mrs. Roosevelt, in the White House Grounds.

7:30 P.M.—Any session thought desirable by the Governors.

#### SCIENTIFIC NOTES AND NEWS

IN the place of Professor Dr. Max Verworn, professor of physiology at Göttingen, who was unable to accept, Dr. Albrecht F. K. Penck, professor of geography at Berlin, has been appointed by the Prussian Ministry of Education to serve as Kaiser Wilhelm professor for 1908-9 in this country, and has been assigned to a seat in the Columbia University faculties of pure and political science. He will give courses in historical and physical geography.

PRESIDENT ELIOT returned from his trip through the middle west on the morning of April 27, after having been absent from Cambridge since March 31. During his absence he delivered, in addition to the six lectures on university organization on the Harris foundation at Northwestern University, no less than twenty-eight other addresses and speeches.

AT the annual meeting of the Society of the Sigma Xi of the University of Pennsylvania held at Randal Morgan Laboratory on May 5, Dr. A. W. Goodspeed was elected president; Dr. John W. Harshberger, vice-president; J.

V. Sanford, M.E., treasurer, and Dr. F. H. Safford, recording secretary.

DR. OSCAR TEAGUE has resigned an assistantship in pathological chemistry in the department of experimental pathology of Cornell University to accept an appointment as pathologist in the Philippine Islands. He is now on his way to the islands, where his address will be Bureau of Science, Manila.

IN connection with the International Congress on Tuberculosis, to be held in Washington from September 21 to October 12 next, the Smithsonian Institution has offered, as we have already announced, a prize of \$1,500, under the Hodgkins fund, for the best treatise "On the Relation of Atmospheric Air to Tuberculosis." This prize will be awarded by a committee appointed by the secretary of the institution in conjunction with the officers of the congress, and consisting of Dr. William H. Welch, Johns Hopkins University, Baltimore, chairman; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York; Dr. George M. Sternberg, surgeon-general, U. S. A., retired, Washington; Dr. Hermann Biggs, of the New York Department of Health; Dr. George Dock, University of Michigan; Dr. William M. Davis, Harvard University, and Dr. John S. Fulton, secretary-general of the International Congress on Tuberculosis.

ON May first Professor W. E. Castle, of Harvard University, lectured at the University of Pennsylvania, under the auspices of the Guernsey Breeders' Association, on "Heredity."

MRS. FLEMING, of the Harvard College Observatory, on the occasion of a reception given to her at the Whitin Observatory of Wellesley College, lectured on the work of the Henry Draper Memorial with which she has been prominently connected since its inception, and in connection with which she has made many discoveries of new stars, variable stars, and stars with peculiar spectra, in addition to the general work of classification in the Draper catalogue of stellar spectra. Mrs. Fleming is an honorary member of the Royal Astronomical Society of London, and, on the occasion

of the completion of the Whitin Observatory, was created by the trustees of Wellesley College an honorary fellow of the college in astronomy.

ON April 2 Mr. R. Lydekker began a course of two lectures at the Royal Institution on (1) "The Animals of Africa"; (2) "The Animals of South America." The Friday evening discourse on April 3 was delivered by Lord Montagu of Beaulieu on "The Modern Motor-car," and on April 10 by Professor J. J. Thomson on "The Carriers of Positive Electricity."

A COURSE of five free popular lectures was arranged by the Chicago Academy of Sciences for Friday evenings in March and April, at eight o'clock. The lectures, which were given in the lecture hall in Lincoln Park, foot of Center Street, were as follows:

March 27—"Daylight: Its Quantity and Quality," by Dr. Olin B. Basquin, associate professor of physics, Northwestern University.

April 3—"World Building," by Dr. Forest Ray Moulton, assistant professor of astronomy, University of Chicago.

April 10—"The Forests of Eastern America," by Dr. Edgar N. Transeau, professor of botany, Eastern Illinois State Normal School, Charleston, Ill.

April 17—"The Birds of the Washington Coast," by Dr. Lynds Jones, associate professor of zoology, Oberlin College, Ohio.

April 24—"Zoological Collecting in British East Africa," by Mr. C. E. Akeley, Field Museum of Natural History.

THE American committee on the Mendel memorial begs to acknowledge the receipt, to April 20, of \$322 on account of this fund, received from 150 senders to whom acknowledgment has been personally made. It is proposed to close this account on the first of June. Those desirous of adding their names to the very honorable roll already obtained are requested to make their contributions before that date. Checks or cash may be sent to Dr. C. B. Davenport, Cold Spring Harbor, New York.

THE annual celebration of the Blue Hydra Society, composed of biological students at the University of Cincinnati, took place on April

24, an imported hemlock, dedicated to the memory of Cuvier, being planted on the campus. The chief address was delivered by Professor C. A. L. Reed, of the Medical faculty, on "The Lessons of Cuvier's Life."

ROBERT CHALMERS, LL.D., of the Canadian Geological Survey, died at Ottawa, Can., on April 9, at the age of seventy-four years. He joined the survey about twenty-three years ago, and conducted work in Pleistocene geology, especially in his native province of New Brunswick.

DR. OTTO KUNTZE, a graduate of the University of Munich, died recently at Iowa City, Iowa. During the past eleven years Dr. Kuntze was a dealer in minerals and rocks, and shortly before his death he placed his entire collection, consisting of thousands of specimens from all parts of the world, at the service of the University of Iowa. Dr. Kuntze was forty-one years of age.

MISS NINA HOLTON, of Newburyport, a member of the staff of the Bureau of Plant Industry, Department of Agriculture, died of typhoid fever on May 5.

MR. JOHN WALTER HASTINGS, A.B. (Harvard, 1905), A.M. (1906), ethnologist during the first year of the Peabody Museum Anthropological South American Expedition under Dr. W. C. Farrabee, died on April 26 from injuries received in an accident.

THE death is announced of Professor Leopold Schrötter von Kristelli, one of the best known and most influential members of the Vienna medical faculty. Only the week before, as honorary president of the Congress of Laryngologists then sitting in Vienna, Professor von Schrötter delivered an inaugural address, in the course of which he celebrated the achievements of Vienna University in developing the science of laryngology.

THE deaths are announced of Dr. Ludwig Schmarde, formerly professor of zoology in the University of Vienna, at the age of eighty-nine years, and of Dr. Wilhelm Scheidner, professor of mathematics at Leipzig, at the age of eighty-two years.

THE thirty-eighth general meeting of the American Chemical Society will, as has been already announced, be held in New Haven, Conn., June 30, July 1 and 2. The sections will meet in the lecture rooms of the Sheffield Scientific School, and will be under the chairmanship of the following members: Agricultural and Food Section—A. L. Winton; Biological and Sanitary Section, Thomas B. Osborne; Physical Section, Frank K. Cameron; Organic Section, Wm. McPherson; Inorganic Section, Philip E. Browning; Industrial Section, Wm. D. Richardson. Papers intended for these sections must be sent to the chairman or to the secretary of the society before June 10. The division of industrial chemists and chemical engineers will be organized at this meeting. Programs will be sent members on June 20. Hotel headquarters will be at the New Haven House.

THE third International Botanical Congress will be held at Brussels from May 14–22, 1910. All communications relating to the congress should be addressed to Dr. E. De Wildeman, general secretary of the organizing committee, Jardin Botanique de l'Etat, Brussels.

MR. A. F. YARROW has offered to give \$100,000 for a tank for research purposes to be erected at the National Physical Laboratory.

THE late Dr. H. Clifton Sorby, F.R.S., of Sheffield, has bequeathed to the Royal Society of London, a sum of £15,000, for a fellowship or professorship for the carrying on of original scientific research. He leaves to the University of Sheffield £6,500, to which is to be added £3,500 which he gave in 1903, making £10,000, as an endowment for a professorship of geology or such other subject as the university may think more suitable. Dr. Sorby also gives to the university a number of books, optical and scientific instruments, geological, mineralogical and natural history specimens, manuscript books, lantern slides, and microscopical objects of rocks and metals, and architectural and other photographs. To the corporation of Sheffield he bequeaths certain scientific articles, pictures, etc. The Sheffield Literary and Philosophical Society

receives a number of books and a sum of £500, and the Geological Society, of London, £1,000.

THE Worcester Art Museum has received under the terms of the will of the late Stephen Salisbury, property valued at \$2,738,000. This sum, added to the amount already possessed by the museum, makes its endowment \$3,332,000.

A BILL has been introduced in the senate for preventing the manufacture, sale or transportation of adulterated or misbranded fungicides, Paris greens, lead arsenates, and other insecticides, and for regulating traffic therein. This bill has been drafted at the instance of the Committee on Proprietary Insecticides of the Association of Economic Entomologists which includes all the official entomologists of the United States.

THE two hundred and fiftieth anniversary of the founding of the government of Philadelphia will be celebrated from October 4 to 10. The University of Pennsylvania and the other educational institutions of the city will take part. There has been appointed a committee on Medical Day which will arrange special exercises. In this connection there will be prepared a volume of 1,000 pages, including 750 pages of text and 250 pages of illustrations. It will contain an account of all the historical institutions, colleges and hospitals that have existed in the city since its founding. The volume will also contain an account of all the medical and scientific societies and medical journals that have been in existence in Philadelphia from the earliest days.

"A CATALOGUE of the Library of Charles Darwin now in the Botany School, Cambridge," has been compiled by Mr. H. W. Rutherford and published by the Cambridge University Press. *Nature* says of it: "Mr. Francis Darwin has contributed an introduction, in which he gives interesting information, supplementary to the account contained in the 'Life and Letters,' concerning his father's methods of work and treatment of books. The collection of books now be-

queathed to the university is not identical with that at Down; thus, the books Darwin wrote and some few others from Down remain in the possession of Mr. Francis Darwin. Darwin's pamphlets are not included in the catalogue, though part of them are on the shelves alongside his books. The introduction points out that Darwin hardly ever had a book bound, and the collection retains to a great degree its original ragged appearance. The general characteristic of the library is incompleteness, hardly any set of periodicals being perfect. The chief interest of the Darwin books lies in the pencil notes scribbled on their pages, or written on scraps of paper and pinned to the last page. Books are also to be found marked with a cypher, as described in 'Life and Letters.' Mr. Francis Darwin provides many facts of interest in connection with some of the more important books included in the library. In a preface, Professor Seward expresses to Mr. Darwin the high appreciation of the botany school and university for rendering the library available to all students."

CONSUL JOHN S. TWELLS, of Carlsbad, furnishes to the *Consular Reports* the following information concerning the discovery that the water in the Austrian uranium mines contains radium of medical value: About eighteen miles from Carlsbad is the small town of St. Joachimstal, where the Austrian government has one of its tobacco factories, and about three miles from that town, up in the hills, at a place which is difficult to reach, are the imperial uranium works, which have become famous during the last few years on account of the radium found in the uranium stone. There is also a government factory at St. Joachimstal where chemical colors are made from the uranium and shipped to all parts of the country. About two years ago the imperial managers of the uranium mines made a report to the government authorities that the water of the mine was found to contain radium, and medical experts have since declared that these waters are of high medical value in certain diseases. During the last fortnight most of the Austrian newspapers have published items according to which the

Austrian government is convinced of the high value of these waters and intends to take charge thereof, construct a proper radium spring, and build hotels, which it will control. The view of the government is, that the beneficial effects of radium in a number of diseases have been admitted by the medical profession, but hitherto the application has been very expensive and treatment difficult. The government believes now that by the discovery of radium in those waters a powerful and at the same time a cheap medium has been found to make the power of radium accessible for bathing purposes.

#### UNIVERSITY AND EDUCATIONAL NEWS

MR. CHARLES HENRY MOORE, barrister at law and fellow of Gonville and Caius College, Cambridge, has bequeathed £5,000 and the residue of his estate, apparently about £30,000, to the master and fellows of Gonville and Caius College.

THE late Dr. Lennander, professor of surgery at Upsala, has bequeathed his entire property to the university to endow scholarships for medical students, for stipends for research work, and for a fund to provide free postgraduate courses in surgery, hygiene and other branches of medicine.

MR. ANDREW CARNEGIE has given the sum of \$200,000 to the Mechanics and Tradesmen's Institute of New York City.

As we have already announced the third session of the National Graduate School of Agriculture held under the auspices of the Association of American Agricultural Colleges and Experiment Stations will open at Cornell University, Ithaca, N. Y., on July 6. The range of instruction will be considerably broader than at previous sessions and includes courses in biochemistry, agronomy, horticulture and plant physiology, dairy husbandry and dairying, poultry, entomology and veterinary medicine. The faculty will include a large number of the leading agricultural scientists of this country. Dr. N. Zuntz, professor of animal physiology of the Royal Agricultural College, Berlin, Germany; Director A. D. Hall, of the Rotham-

sted Experimental Station, England; Professor L. B. Mendel, of Yale University; Professor S. H. Gage, of Cornell University, and Professor C. B. Davenport, of the Carnegie Institution, will also deliver courses of lectures. Dr. A. C. True, director of the U. S. Office of Experiment Stations is dean of the school, and Professor G. N. Lauman, of Cornell University is registrar.

As the result of the appointment of Edwin C. Holden, of New York, to the professorship of mining engineering at the University of Wisconsin, the present group of electives in mining engineering in the college of engineering of the University of Wisconsin will be developed into a regular four-year course for the training of mining engineers.

At the recent meeting of the regents of the University of Wisconsin Professor Louis Kahlenberg was appointed director of the newly-established course in chemistry.

MR. ARTHUR L. WALKER has been appointed professor in the department of metallurgy at Columbia University.

MR. E. L. POTTER, a member of the 1908 graduating class in the animal husbandry department of the Iowa State College, has been appointed instructor in animal husbandry (in charge of the department) in the Oregon Agricultural College.

DR. VICTOR J. CHAMBERS, now instructor in organic chemistry at Columbia University, will succeed Professor A. Lattimore at the University of Rochester. Dr. Chambers received the degree of bachelor of science at Rochester in the class of 1895. From Johns Hopkins he received the degree of doctor of philosophy in 1901.

AUSTIN teaching fellows at Harvard University have been appointed as follows: Harold Eugene Bigelow, A.B. (chemistry), Edgar Davidson Congdon, A.M. (zoology), George Thomas Hargitt, A.M. (zoology), George Leslie Kelley, S.B. (chemistry), Chester Couch Pope (engineering), Emile Raymond Riegel (chemistry), Edric Brooks Smith (engineering).